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Contents.

	PAGE
Theory *v.* Practice	467
I.B.F.—Twenty-fifth Annual Convention	469
Iron and Steel Industry of Australia	470
Random Shots	470
Institute of British Foundrymen—Leicester Congress—Annual Convention Banquet	471
Souvenir Photographs	474
American Iron and Steel Institute	474
Engineering Exhibition at Cardiff	474
Iron Foundry Costing	475
Catalogues Received	477
Malleable Castings	478
Mr. Leon Thomas Honoured	481
Correspondence	468, 481
Trade Talk	482
Contracts Open	482
Obituary	482
Personal Paragraphs	482
A Posset Pan	482
Welding of Stainless Steel	482
The Causes of Failure of Wrought-Iron Chains	484
Iron and Steel Markets	484

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Theory *v.* Practice.

Knowledge can only arise out of practical experience or practice, and in order that this knowledge can be conveyed satisfactorily to others or recorded for the benefit of posterity, it must of necessity be assembled into some orderly and systematic form. It is partly the business of science to endeavour to evolve some sort of law and order from accumulated experience or knowledge, and the orderly systems or laws thus evolved constitute the major portion of what is commonly understood by the word theory. Under any set of progressive conditions it must be clearly evident that the accumulation of knowledge must be in advance of the consolidation of knowledge into orderly or systematic form, and this, in other words, is the same thing as the oft used expression, practice comes before theory. Of necessity the very finiteness of true knowledge indicates the priority of practical experience.

In metallurgical science, the section dealing with the constitution of alloys, accumulated experience or knowledge in its systematised form is typified by our equilibrium diagrams. Incidentally equilibrium diagrams would be much better understood and certainly much better appreciated amongst foundrymen by adopting the very simple expedient of altering their title to constitutional diagrams. This title, which is equally as satisfactory as the former, is full of meaning, and truly indicates that these diagrams embody our accumulated experience of the constitutional features of alloys throughout the various states and conditions in which we are able to observe them. Like all other items of knowledge, our constitutional diagrams cannot be stretched in their interpretation beyond the well-defined conditions over which they apply, without trespassing into the realm of speculative theory, or speculation which is unsupported by facts or practical observations.

It is of particular importance to remind foundrymen in general that the constitutional diagram as a method of recording our knowledge of alloys is derived from a very much vaster field of inquiry than that of comparatively simple metallic alloys, and is actually the method adopted in dealing with all types of solutions and mixtures. It may be said that real systematic knowledge of metallic alloy systems dates from the discovery that such systems were amenable in theoretical treatment to the rules and regulations derived from the broader field of inquiry of solutions in general.

From the practical standpoint we are frequently disappointed by the manner in which true theory falls short of our superficial expectations in dealing with new problems. For example, in spite of the masterly analysis of the conditions governing heat transmission given to us by Fourier, and universally known as the Fourier theory, its application to new practical problems is so often confused by the assumptions of lag, interference, lack of steady stable conditions, that it is easier to adopt the practical and often laborious course of direct measurement in dealing with practical problems. Again, in practical hydraulics we find that the existence and reality of such things as turbulence and fluid friction more often than not preclude the application of the theories of hydrodynamics in dealing with practical problems. The theoretical yields of chemical processes expressed by simple equations in practice are affected by so many extraneous conditions that practical scale experiments are the only methods available of determining the yields under industrial conditions. Thus it is that, whilst the theoretical conditions are rarely realised in practice, it is the theoretical aspect which enables us to evaluate the influence of extraneous conditions, and in this manner only are the shortcomings of our existing knowledge revealed, and the direction in which true progress is to be made indicated.

In short, the theoretical constitutes the only standard of reference, and it must be obvious that those people who clearly understand why and in what respect theory is inadequate in dealing with any specific problem are more capable of satisfactorily dealing with the problem than others groping about in darkness.

It must be admitted in special reference to cast iron that, whilst we have a vast accumulation of experience, it has not yet been found possible to arrange this in a systematic manner which will satisfactorily cover all the facts and provide a theory of the constitution of a simplicity comparable with that of some of the other industrial alloys. This might be readily understandable to those acquainted with the complexity of industrial cast iron, and it is, therefore, of great importance to realise that this statement is equally true in the case of the purer simple alloys of which we have chosen to consider that industrial cast irons are made up. It is not rational, therefore, to expect that the substitution of the complex industrial cast irons in our researches and investigations will enable us to attain an orderly conception of the constitution of cast iron more readily. That this is the situation at the present time is by no means justifiably interpreted as indicating that we have failed to solve the problems connected with the constitution of cast iron. The situation can only be interpreted as indicating the necessity for further investigation of a still more complete and exhaustive nature, and, in fact, clearly indicates the direction which further investigations should take. There can be no doubt that the continuance of the most careful investigation into the iron-carbon-silicon system inaugurated by Dr. Hanson, under the auspices of the British Cast Iron Research Association, and presented to the Iron and Steel Institute last year, will do much to help us in systematising our existing accumulation of knowledge. The continuance of this work into the higher regions of silicon and carbon content, with special reference to the region immediately above and below the eutectic temperature, cannot fail to be fruitful at the hands of this investigator. The fears of our ability ever to understand the constitution of complex industrial cast irons begin to fall away when we speculate, even legitimately, on the possibilities of the new tools available to metallurgists in the shape of X-ray spectrographic analysis, so remarkably handled by Westgren and his colleagues in the recent investigation of the iron-carbon-chromium alloys.

Finally, to invert Mr. Shaw's phraseology, we do not criticise industrial research on industrial alloys, nor, in fact, can we criticise such research. We do state, however, that it is inevitable to a true and full understanding of the constitution of industrial cast iron that we have a true and full understanding of the constitution of the simple alloys of the components of industrial cast iron.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"A Clean Start."

To the Editor of The Foundry Trade Journal.

Dear Sir,—I did not reply to your second editorial of June 14, in the hope that some other reader would criticise either my position, or yours. The original paper was written with that object in view. I would remind you, Sir, that "strongly adhering to a previous attitude" is not proof, but only personal opinion. I will take only three out of many problems. For the last five years much has been written and many claims made for castings having an all-pearlitic structure. I wonder, amongst the many claimants who state they regularly produce an iron of this type, what advantages are proved; which particular pearlitic structure they obtain? From a close study of the results of the 60 melts given by Hamer, in your issue of December 29, 1927 (and it must be remembered these results were obtained under very well-controlled conditions), I abstracted all the results that microscopically gave an all-pearlitic structure across the 1.2 in. bars when cast in moulds at normal temperatures.

Table II.—*Bars Showing Pearlitic Structure at 450 deg. C.*

No.	T.C. + Si.	Transverse.			Tensile.			Structure.			Combined Carbon.			T.C.	Si.	Mn.	P.	S.	Brinell.		
		450 deg.	250 deg.	N.	450 deg.	250 deg.	N.	450 deg.	250 deg.	N.	450 deg.	250 deg	N.						N.	250 deg.	450 deg.
12	4.02	48	41.5	31.5	27	22	17	P	M	M	0.95	1.86	2.56	3.34	0.68	1.21	0.42	0.09	246	194	126
13	4.02	—	—	—	—	—	—	P	M	M	0.89	2.33	2.91	3.24	0.78	1.04	0.43	0.11	267	214	135
16	4.17	—	—	—	26	25.5	24	P	P+C	M	0.89	1.00	1.89	3.35	0.82	1.10	0.42	0.10	187	159	122
19	4.12	—	—	—	—	—	—	P	M	M	0.89	1.71	1.76	3.30	0.82	0.95	0.35	0.10	210	171	123
22	4.01	53.3	40.5	30	30.3	29	21.5	P	M	M	0.86	1.68	1.81	3.08	0.93	1.02	0.37	0.13	267	214	139
26	4.06	41	48	46	28.5	29.5	29.1	P	P+C	P+C	0.89	0.93	0.91	2.7	1.36	0.77	0.50	0.09	161	142	112
40	4.36	—	—	—	—	—	—	P	P+C	M	0.86	0.98	1.33	3.52	0.84	0.74	0.43	0.09	152	125	112
43	4.2	—	—	—	21	22	23	P	P+C	M	0.93	1.30	1.48	3.54	0.70	0.92	0.41	0.06	161	134	110
45	4.33	—	—	—	—	—	—	P	P+C	M	0.94	1.25	1.79	3.57	0.76	1.04	0.42	0.08	161	128	112
49	4.12	46	46	40	26	25	19	P	M	M	1.00	1.44	2.72	3.38	0.74	1.00	0.36	0.08	213	160	138
64	4.08	42	—	39	27	25	—	P	P+C	M	0.98	0.95	1.85	2.90	1.18	0.83	0.06	0.08	204	159	130
70	4.15	—	—	—	21	22	—	P	M	M	0.96	1.44	2.68	3.50	0.65	0.68	0.04	0.09	195	128	103
75	3.69	47.5	47	46	—	—	—	P	M	W	0.97	1.79	2.6	2.88	0.81	0.85	0.23	0.11	239	162	137
17	4.06	44	—	—	26	25	25	P	M	M	0.89	1.64	2.31	3.22	0.84	0.89	0.40	0.11	225	192	127
94	4.09	—	—	—	—	—	—	P	P+C	M	0.96	1.14	2.14	3.03	1.06	1.93	0.07	0.05	192	135	124
100	4.45	32	—	34	28	—	—	P	P+C	M	1.09	1.23	1.80	3.7	0.75	0.96	0.32	0.05	126	113	104

From the above one gathers that there must be a mottled structure in a cool mould if you are to get the benefit of a heated mould. The drop in C.C. is remarkable, as much as 2 per cent. in one case, against only a drop of 0.04 per cent. if the formation and its troubles. By lowering the P. to 0.3 per cent. this trouble was stopped." Yet from my position as Director of Grey-Iron Castings I know many thousands of these bombs were made with 0.8 per cent. P., without trouble. Bolton, in a Paper published in "The Foundry," entirely discredited the phosphide-eutectic network theory. Yet Cook, only in April, equally defended it. Piwowarsky and Lowry both state that phosphorus up to 0.9 per cent. gives increased wear. Lehmann, from actual trial with brake blocks, gives exactly the opposite result. Take again the recent investigations on the effect of nickel. Houston, in "The Foundry" states that two of nickel is equal in effect to one of silicon, Everest, on the other hand, finds that the ratio of nickel to silicon is about four to one. So if one wishes to gain the effect of 0.3 per cent. silicon is one to add 0.6 per cent. Ni, or 1.2 per cent.? Quite a difference!

The very vagueness of many results led me to write the recent paper. We should at least have some results under definitely controlled conditions that could be used as guides and could be repeated under works conditions, because the same materials could be employed. You suggest I had in mind a six-phase diagram. Nothing was further from my thoughts, knowing the almost impossibility of expressing it, even if one obtained the data. You will probably use that sonorous phrase that such work is not fundamental. A term that is often used to cloak ignorance of the question, and is often in keeping with "Mesopotamia" and often means as much.—Yours, etc.,

J. Shaw.

2, Parkstone Avenue, Southsea.
July 22, 1928.

Table I.—*Maurer's Diagram. Bars Showing Pearlitic Structure at Normal Temperatures.*

No.	T. C. + Si.	Transverse.			Tensile.			Structure.			Combined Carbon.			T.C.	Si.	Mn.	P.	S.	Brinell.		
		450 deg.	250 deg.	N.	450 deg.	250 deg.	N.	450 deg.	250 deg.	N.	450 deg.	250 deg	N.						N.	250 deg.	450 deg.
6	4.78	—	—	—	—	29	28.8	—	P	P	—	0.84	0.81	3.12	1.66	1.0	0.40	0.09	141	138	—
8	4.63	—	—	—	—	—	28.7	—	P	P	—	0.86	0.94	3.24	1.39	0.95	0.41	0.09	149	136	—
9	4.37	—	—	—	—	27	30	—	P	P	—	0.81	0.92	3.2	1.17	1.00	0.39	0.09	151	137	—
14	4.46	40	43	49.8	24	26	27.2	P	P	P	0.91	1.03	1.08	3.35	1.11	1.07	0.41	0.05	140	132	121
24	4.43	43	45	50	25.5	26.5	28.3	P	P	P	0.79	0.82	0.84	3.13	1.20	1.08	0.41	0.11	151	133	131
25	4.6	44.5	44	43.3	25	25.5	27.1	P	P	P	0.85	0.87	0.91	3.20	1.40	1.12	0.41	0.11	143	137	126
27	4.61	—	—	48	—	—	27.9	P	P	P	0.79	0.86	0.81	3.14	1.47	1.00	0.42	0.08	149	136	121
28	4.77	43	45	47.8	25	26	27	P	P	P	0.70	0.77	0.83	3.14	1.63	1.12	0.42	0.11	145	135	126
29	4.62	42	48	45	24.7	25.2	26	P	P	P.	0.73	0.76	0.79	3.08	1.54	0.88	0.41	0.08	144	130	121
32	4.91	45.4	49.5	45.4	24	52.5	26.2	P+Fe	P	P	0.71	0.78	0.80	2.98	1.93	0.97	0.43	0.10	140	133	117
36	4.88	40	43	46	23.6	24	25.5	P+Fe	P	P	0.64	0.73	0.73	3.06	1.82	0.98	0.42	0.12	145	133	118
42	4.83	40	45	49.5	21	22.5	26.3	P+Fe	P	P	0.76	0.77	0.78	3.26	1.57	0.85	0.44	0.08	135	124	113
46	4.5	38	40.5	46	19	20.5	23.7	P	P	P	0.82	0.90	0.97	3.55	0.95	1.27	0.39	0.07	133	118	109
53	4.36	46	46	47.5	24	25	26	P	P	P	0.85	0.87	1.01	3.36	1.0	0.92	0.37	0.09	138	126	123
54	4.74	42	45	48.8	21.5	23.5	24.3	P+Fe	P	P	0.81	0.86	0.83	3.37	1.37	1.07	0.34	0.08	137	130	120
59	4.33	49.5	51.5	51	24.5	26.5	24	P	P	P	0.81	0.84	0.80	2.7	1.63	0.91	0.21	0.10	158	145	135
60	4.59	41	42	50	22.5	23	23	P	P	P	0.76	0.72	0.73	2.78	1.81	0.72	0.18	0.08	147	132	126
62	4.78	42	45	47.5	16	16.9	19.5	P	P	P	0.86	0.92	0.90	3.50	1.28	1.07	0.19	0.08	124	111	104
63	5.08	31	36	35	15.5	17	19.5	P+Fe	P+Fe	P	0.87	0.86	0.91	3.43	1.65	1.03	0.20	0.07	128	115	110
66	4.46	30	31.5	33.5	16.5	16.5	19.3	P	P	P	1.07	1.11	1.09	3.67	0.79	0.94	0.19	0.06	145	105	103
74	4.6	25	26	32	12	13	15.5	P	P	P	1.08	1.05	1.07	3.75	0.85	0.85	0.05	0.05	112	100	92
76	5.24	22	24	25	10.5	12	13	P+Fe	P+Fe	P	0.99	1.03	1.05	3.70	1.54	0.80	0.06	0.04	102	92	84
79	4.31	42	45	47	23	23	23	P	P	P	0.83	0.81	0.81	2.41	1.86	0.80	0.12	0.06	164	147	140
82	4.53	38.5	—	45	23	24.5	24.5	P	P	P	0.84	0.88	0.84	2.55	1.98	0.85	0.10	0.07	154	145	128
83	4.29	41	41	43.5	24.5	24	24	P	P	P	0.90	0.89	0.84	2.77	1.52	0.80	0.12	0.09	149	140	135
84	4.97	38	40	46	21	23	25	P+Fe	P	P	0.64	0.80	0.82	2.74	2.23	0.80	0.09	0.07	151	138	121
98	5.25	21	25	27	10	11	13.5	P+Fe	P+Fe	P.	0.86	0.87	0.87	3.81	1.44	1.23	0.06	0.06	106	92	90

From the above table we glean that it is possible to have tensile tests giving 8.27 tons and 19 tons per sq. in., each with a pearlitic structure right across the bar. That it is possible to have T.C. + Si varying from 4.29 per cent. to 5.25 per cent., still cast under the same conditions and yet yielding an all-pearlitic structure. That the Brinell may vary from 102 to 164. That it is possible for the C.C. to vary in different bars of the same size from 0.73 per cent. to 1.09 per cent. (no doubt there was some free cementite in the latter that was not discernible under the microscope) and yet be all-pearlitic. That if one has an all-pearlitic structure when the bars are cast in a mould of room temperature, heating up the mould to 450 deg. C. has little effect on the C.C. in a 1.2-in. bar. It is only, on the average of 27, reduced from 0.87 per cent. to 0.83 per cent. That also the all-pearlitic structure is retained in 19 cases when cast into either the cool mould or the 450 deg. C. mould, but there is a decided drop in tensile, transverse and Brinell. So if there is a pearlitic structure at normal mould temperature, heating the mould does not in many cases destroy the pearlitic structure, but alters it and weakens the casting.

Carrying the matter a step further, the following table contains all the samples that were all-pearlitic only when the mould was heated to 450 deg. C.

bar is pearlitic at normal mould temperatures. The tensile and transverse tests are much higher in the heated mould than those in the cool mould, while the Brinell is 50 per cent. lower. So under these conditions the heated mould is an advantage, but even here the tests vary very much. The effect of lower carbon was shown in my previous reply. A consideration of the above tables show how vague are many of the statements with which the Press has been inundated. Take again the effect of phosphorus. The ternary diagram Fe-C-P has been at our disposal for years, together with some work having Si added. Yet to-day we have quite divergent views held by men with high technical training, who are quite conversant with these diagrams. Hurst, in the Proceedings, I.B.F., 1917-18, stated phosphorus was highly detrimental to Diesel-engine castings. Buchanan and Cook disagreed, stating that up to 1 per cent. had been used without failure. Again Campion, in a Paper, Foundry Trade Journal, April 23, 1925, stated for this same work low phosphorus was both unnecessary and undesirable, Arnott stated that with this he entirely disagreed. Harley advocates P. approximately 0.15 per cent. for his motor cylinders, owing to drawing, etc., yet one of the largest makers of motor cylinders is using 0.5 per cent. and over. Rhead stated "the unsoundness of the 9.5 bombs was very disastrous to many makers, due entirely to the phosphide eutectic

Motor Cycle Race Performances.

To the Editor of The Foundry Trade Journal.

Sir,—Your readers will probably be interested to know that the Birco Motor Cylinder Company, Limited, of West Bromwich, supplied the cylinders for the following motor cycles in the Isle of Man motor-cycle races:—

Junior Race.—1st, 2nd and 5th, and

Senior Race.—1st, 5th, 6th and 7th.

In every case the cylinders were made from refined cylinder pig-iron.—Yours, etc.,

G. T. Lunt.

Darlaston Blast Furnaces, Darlaston.
June 23, 1928.

The Stanton Ironworks Company, Limited, near Nottingham, have secured a contract for 50,000 tons of cast-iron segments for the Mersey Tunnel.

Messrs. Oldham & Son, Limited, electrical and mechanical engineers, of Manchester, have opened a new London depot at 40, Wicklow Street, Kings Cross, W.C.1.

We regret to announce the death of Mr. Paul Roger, as a result of an automobile accident. Many Britishers will remember Mr. Roger as presiding over the opening ceremony at the foundry exhibition held in Paris in 1913. He was also at one time a president of the Paris Chamber of Commerce.

INSTITUTE OF BRITISH FOUNDRYMEN.

TWENTY-FIFTH ANNUAL CONVENTION.

THURSDAY, JUNE 14.

Morning Session.

Mr. S. H. Russell, President, in the chair.

The PRESIDENT announced that one of their oldest members in years, Mr. W. J. Tarrant, had unfortunately died most suddenly at his hotel. Though personally he had not the privilege of knowing Mr. Tarrant, he was very well-known to many of the members, and was a regular attender at their recent Conferences. As soon as they had heard this sad news, their Secretary, Mr. Makemson, went to the hotel and expressed his sympathy with the relatives. The Secretary and, in the absence of the Branch-President, their Branch Secretary, would represent the Institute when the body was removed to the station to be taken home. Mr. Tarrant had reached the age of 82 years; and, although it was very depressing for his relatives, perhaps it was rather a happy way for a man of that age to pass away whilst still in business.

At the request of the President, the company stood for a moment in silence.

Technical Papers were then presented for discussion, there being held in an adjoining room a special sitting devoted to non-ferrous metallurgy, under the chairmanship of Mr. Wesley Lambert. At the close of the discussions, the chairman called upon Mr. H. H. Moore, the treasurer of the Hospitality Fund.

Contributions to Hospitality Fund.

MR. H. H. MOORE appreciated the opportunity being given to him of thanking on behalf of the Convention Committee all those who had so kindly assisted to provide the necessary funds to enable them to offer what he hoped would have been found at least up to the usual standard of entertainment and general hospitality which prevailed at their annual Conferences. The Conference provided an excellent meeting-place for all engaged in the foundry industry and foundry trade and commerce. It was gratifying to know that the supply sections were still ready to help them, and in that way they benefited the industry in what might be regarded as a matter of mutual interest. But the major portion of their hospitality fund contributions came, as must always be the case, from the larger firms situated in the district where the Convention was taking place. Those firms had contributed very liberally. In the East Midlands district they were somewhat unfortunate, because, although they embraced Leicester, Derby and Loughborough, they had not the same number of large firms as existed in an area like Glasgow or Sheffield. But it was gratifying for them to know that the large firms interested had come along in a very generous manner. (Applause.) The contributions to the Hospitality Fund had reached over £500. (Applause.)

He might refer to the future Hospitality Fund, because it was not only their own that they had to think about, but there were future Conventions. Probably their members would note that they could be of the very greatest assistance to the Hospitality Committees in beginning propaganda fairly early. On behalf of the Convention Committee he thanked all the contributors to the Hospitality Fund, and he hoped all the members would realise the value of the Convention in the interests of the industry as a whole. (Applause.)

Upon the close of the Conference Session on Thursday morning, June 14, the whole of the members and their ladies journeyed by special train to Derby. The train was composed of dining-car stock, and luncheon was served *en route*.

On arrival at Derby the ladies were conveyed by motor coaches to the works of the Royal Crown Derby Porcelain Company, Limited. After inspecting the works, they proceeded to the "King's Café," where they were entertained to tea by the Convention Committee.

The members also spent the afternoon in works visits. A large party visited the works of Ley's Malleable Castings Company, Limited. Another group inspected the L.M.S. Railway works, where they were received by the Chief Mechanical Engineer, Sir Henry Fowler, whilst a third visited the works of Messrs. Rolls Royce, Limited. At all three works the members were entertained to tea and the thanks of the Institute were addressed to the respective directors and staffs.

On the conclusion of the works visits the party rejoined the special train at Derby and proceeded to Matlock Bath, where they were entertained to dinner by the Convention Committee at the Grand Pavilion. Mr. H. Pemberton, chairman of the East Midlands Section, presided.

MR. F. J. COOK, Past-President of the Institute, expressed the thanks of the members and their ladies to the East Midlands Branch for their hospitality. He said the members of the Institute were very grateful to the East Midlands Branch for organising the Conference, and he paid a tribute to the Conference Committee, particularly their President and Secretary for the excellent arrangements which they had made and for the wonderful organisation which they had established for the management of the Conference.

The President-Elect.

MR. WESLEY LAMBERT, A.K.C.

Mr. Lambert, who is to preside over the International Foundry Congress to be held in London next June, has been the manager of the Metallurgical Department of Messrs. J. Stone & Company, Limited, Deptford and Charlton, since 1912. He received his early training at Roan School, Greenwich, and his technical education at King's College, where he received the Jelf Medal and the Cunningham Prize. In 1890 he was appointed Assistant Metallurgist at the Royal Gun Factories, Woolwich. In 1894 the Ottoman Government employed him in the capacity of Metallurgist and Lecturer in Engineering and Chemistry. For these services he was decorated by H.I.M. the Sultan with the Order of the Medijidieh. Returning to England, Mr. Lambert was appointed Chief Metallurgist at the Royal Gun Factories, Woolwich. For several years he acted as a special lecturer to the Sir John Cass Technical Institute (University of London), and his connection therewith is commemorated by the gift of a medal bearing his name. Mr. Lambert has contributed a large number of papers before technical societies. He is a Fellow of the Chemical Society and is also on the membership roll of the Institute of Civil Engineers, the Institute of Naval Architects, Institute of Marine Engineers, and the American Society for Testing Materials, whilst he is a member of various Committees and Panels of the B.E.S.A. The President-elect is amongst the most widely travelled members of the Institute.

MR. J. T. GOODWIN, ex-President, seconded the vote of thanks, and referred to the value of social intercourse which was such an important feature of the Conference.

MR. F. P. WILSON, the newly-elected Vice-President, supported the resolution in a witty speech.

MR. H. PEMBERTON replied on behalf of the Conference officers and Committee, and expressed the pleasure which the East Midlands Branch had in entertaining the Conference. He paid a tribute to the work of his fellow officers, and said that whatever success had attended their efforts was due to the spirit of goodwill and co-operation which prevailed.

A musical programme was provided by Miss Constance Pemberton (daughter of the Chairman), Miss Vera Burrows, Messrs. Ronald Gates, Peter Moore and Fred. Todd. The party then returned by special train to Leicester.

FRIDAY, JUNE 15.

The morning of Friday, June 15, was given over to works visits, mostly in Loughborough, although a party of ladies visited the works of Liberty Shoes, Leicester, before proceeding to Loughborough. The remainder of the members and ladies travelled to Loughborough by motor coach, where the ladies visited the works of Zenobia, Limited, perfume manufacturers.

Most of the male members of the party took part in visiting works of Messrs. Herbert Morris, Limited, the well-known manufacturers of cranes and lifting machinery. Another group visited the works of Messrs. John Taylor & Company, Limited, the world famous bell founders, and witnessed one of the oldest branches of the foundrymen's art. Another group visited the Loughborough College, which has established a reputation for the practical and technical training of engineers.

At the conclusion of the various visits the party assembled near the Loughborough Carillon, where a recital was given by Mr. W. E. Jordon, the Borough Carillonneur.

The whole of the members and ladies were afterwards entertained to lunch by Messrs. Herbert Morris, Limited, in the Town Hall. The guests included His Worship the Mayor of Loughborough, and also representatives of the various works which had been visited during the morning.

MR. W. H. PURNELL, J.P., vice-chairman of Messrs. Herbert Morris, Limited, presided, and after the toast of "The King" had been honoured, the Chairman welcomed the guests in the name of his Company. He pointed out that although a small town, Loughborough was industrially very progressive, and it had a very large variety of industries for a town of its size. Loughborough was also an important agricultural centre, and was well known as an important hunting headquarters.

MR. S. H. RUSSELL, President of the Institute, expressed the thanks of the members and ladies to the directors of Herbert Morris, Limited, for their hospitality. He also thanked the directors of the various works which had been visited by the members and ladies.

MR. H. H. MOORE, Past-President of the East Midlands Branch and a director of Herbert Morris, Ltd., replied on behalf of his firm, and said that they were both delighted and honoured at the opportunity of entertaining the members and ladies of the Institute.

Upon the conclusion of the luncheon the party rejoined the motor coaches in which they had journeyed from Leicester and drove through the beautiful Charnwood Forest district. A halt was made at the charming cottage of Mr. S. A. Gimson, a Past-President, where tea was provided. The visit which members paid to Mr. Gimson's cottage some years ago still remains a pleasant memory with the older members of the Institute, many of whom were glad to again have the opportunity of renewing old memories. The cottage was designed by Mr. Gimson's brother, and stands in an elevated, though sheltered, position which commands a very wide view for many miles around.

Later in the afternoon the members returned to Leicester, and the official programme of the Convention was thus brought to a close.

THE GREAT WESTERN RAILWAY'S ironfoundry and pattern-makers' shop at Cardiff has been closed. Any work required will now be done at Swindon.

Iron and Steel Industry of Australia.

MR. J. L. PEARSON (the Inspector of Mines), in the course of his Report published by the South Australia Department of Mines, dealing with the "Iron Mining Industry at Iron Knob and Whyalla, South Australia," remarks that the first ironworks within the Commonwealth were established at Mittagong, New South Wales, as far back as 1852, and at Esbank, near Lithgow, in the same State, a second plant was erected in 1875; but in both cases the production was small. In 1907 works on a much larger scale were erected at Lithgow by the late Mr. Wm. Sandford. These were taken over in the following year by Hoskins, Limited, and are still in operation. There was, however, no notable expansion in the output until 1915, when the establishment of the Broken Hill Proprietary Company Steel Works, at Waratah, near Newcastle, New South Wales, marked a new period in the industry. The iron ore required at these works is supplied from the Iron Knob district in South Australia, where the Company hold under lease from the State Government areas embracing four large deposits of ore. Iron Knob is situated 41 miles by road W.S.W. from Port Augusta and 33¼ miles W.N.W. from the shipping port of Whyalla, with which it is connected by a 3-ft. 6-in. gauge private tramway, built and owned by the Company. The deposits at present being exploited, viz., the Iron Monarch and Iron Knob, are at Iron Knob, while the Iron Prince and Iron Baron ore bodies are situated in the Middleback Ranges, 17 miles south.

At Iron Knob the iron-ore deposits and associated rocks form a meridional ridge a mile and a-half in length rising to a height of about 620 ft. above the adjacent plain country. The southern and higher portion is a large dome or boss, the central portion of which constitutes the Iron Monarch deposit. The central portion of the ridge consists of ferruginous chert or quartzite, while the backbone of the northern portion is formed by the Iron Knob ore body. At the Middleback Range the hills containing the Iron Baron and Iron Prince deposits have a maximum elevation of over 500 ft. above the surrounding plains, and consist of a schistose or slaty rock containing intercalated hematite and siliceous material. The remainder of the ridge consists of hematite in vein or replacement masses.

In all the bodies the ore consists principally of hematite, with smaller occurrences of magnetite and some limonite. The proved ore available to the level of the plain in the Iron Monarch, and within the scope of open-cut work on the other ore bodies, amounts to about 150,000,000 tons, with the probability of existence of a considerable quantity of additional ore. In the Iron Knob deposits the gangue minerals average less than 5 per cent., the balance of the ore being composed of iron and manganese oxides. The manganese ore is irregularly distributed through the Iron Monarch body, and care has to be taken in mining to so proportion the production from the different faces that the furnace ore does not contain an excess of manganese. The best ore as blasted from the solid contains 69 per cent. metallic iron, and the contents of the average shipping ore are 65.67 per cent. iron and 1.69 per cent. silica.

The Iron Knob leases were acquired by the Broken Hill Proprietary Company in 1899, and developed to provide supplies of iron flux for the lead smelters at Port Pirie. Production from the Iron Knob ore body commenced in 1901, and up to the end of 1919, when regular shipments to Port Pirie ceased, over 1,000,000 tons of iron ore were supplied as flux for use in lead-smelting. In 1915, to provide the extra tonnage required for steel-making, productive operations were started at the Iron Monarch. Since that time over 4½ million tons of ore have been shipped to Newcastle, of which 583,745 tons represent the 1926 output. To handle this increased tonnage the shipping jetty at Whyalla was lengthened and equipped with a conveyor system which delivers the ore from the shore storage bins into the holds of the steamers for transport by sea to the steel works.

Newcastle Steel Works, New South Wales

The first furnace was blown in at the Newcastle Steel Works on March 8, 1915, and the first rail manufactured on the 24th of the same month. The plant comprises three blast furnaces of a daily producing capacity of 1,300 to 1,400 tons of pig-iron, and a fourth furnace of 100 tons capacity reserved for the manufacture of ferro-manganese and special-grade foundry iron. There are nine 65-ton basic open-hearth furnaces equal to producing 9,000 tons of steel per week, and for rolling the steel into blooms and billets there is a 35-in. blooming mill with a capacity up to 10,000 tons per week. The finishing mills include a 28-in. rolling mill for the manufacture of heavy rails, billets, structural steel, etc.; an 18-in. mill for making light rails, structural shapes, merchant bars, and billets; 12-in. and 8-in. mills for merchant bars; a fish-plate mill, as well as a continuous mill for the production of wire rod. There is a steel foundry containing one acid open-hearth furnace, and an iron foundry in which hot metal direct from the blast furnaces is used.

The plant includes also 224 coke ovens of the Semet-Solvay by-product type, and in connection with this department there are plants for the production of sulphate of ammonia and benzol, solvent naphtha, toluol, road-making tars, oils, and sublimed naphthalene. The consumption of coal for all purposes is upwards of 900,000 tons per annum, and the Company has acquired coal-bearing lands in the district, on which mines are now being developed with a view to augmenting and securing future coal supplies.

To supply the flux and refractories requirements of the Newcastle works, limestone is obtained from Tasmania, and limestone, silica, dolomite, and magnesite from quarries in New South Wales. Allied industries have also been established in Newcastle and Sydney for the conversion of the steel into galvanised goods, wire netting, wire ropes, fencing and other wire; and works for the production of railway tyres, axles and steel castings have also been established in the district.

From the commencement of operations up to November 30, 1926, the material produced was as follows, in tons:—Pig-iron, 2,322,107; steel ingots, 2,276,464; foundry ingots, 38,666; blooms and billets, 801,602; rails (all sizes), 721,955; structural steel, 181,611; steel plates, 13,700; fishplates, 42,180; guard plates, 6,430; munition steel, 17,900; merchant bars, 403,870; steel sleepers, 5,205; wire rod, 359,615.

Although handicapped by a comparatively limited market, and severe competition from oversea producers operating under less stringent conditions, the iron and steel industry carried on by the Broken Hill Proprietary Company is so important a factor in the industrial progress of the Commonwealth that it may be regarded as a national necessity. The Iron Knob ore deposits supply a great proportion of the raw material now used in the industry, and directly support a considerable population in South Australia, Victoria and Tasmania, as well as a much greater one in New South Wales, and also furnish indirect employment for a large number of men in the supply and transport of raw materials and distribution of products throughout Australia. This indicates the great value of the iron-ore deposits of this State, and should secure to South Australia for many years to come the leading place in the production of iron ore in Australia.

According to the Report just issued by the Department of Overseas Trade on the Economic and Commercial Situation of Australia (to June, 1927), by R. W. DALTON (Senior British Trade Commissioner in the Commonwealth of Australia), an important development in the iron and steel industry of New South Wales is now taking place (in addition to the activities of the Newcastle Works), in that, under agreement with the New South Wales Government, Messrs. Hoskins & Company are building a new iron and steel works at Port Kembla.

Random Shots.

It is an old adage that "Distance lends enchantment to the view," and this is not infrequently true of distance in time as well as distance in space. In the case of the Leicester Convention, however, there was no need to wait for any such assistance. If there are any dissentients from the general view that it was a wholly delightful and auspicious occasion—well, "Marksman" has yet to meet them.

* * *

With the passage of time, however, the various features do assume a new and possibly a truer perspective. Quite the most outstanding fact now appears to have been the immense interest taken in Leicester's staple products—was it not, for instance, generally agreed that the local girls were admirable advertisements for home products, stockings especially? And did not the Mayor point out that if a girl pays ten shillings for a pair of silk stockings (made in Leicester, no doubt), she not unnaturally objects to being unable to show more than nine shillings' worth? Mr. Wesley Lambert went further, and congratulated the city on its contribution to the Brighter London movement.

* * *

It seems just possible, however, that there might have been a fly in this particular ointment. "Marksman" can picture the sad fate of the enthusiastic husband who went home to his wife with a glowing description of the kindness of the Convention Committee in presenting every lady visitor with a pair of silk stockings, without having had the forethought to still the pangs of envy in advance by a suitable offering.

* * *

The visitors were also keenly appreciative of the generous action of the Mayor in giving them the freedom of the tram and omnibus services. They did not all show their appreciation quite so wholeheartedly, however, as the Scot among them (unidentified), who spent the whole of the morning following the announcement having free rides.

* * *

Envy was the sentiment aroused in many breasts by the De Montfort Hall. It is not every city in the kingdom that possesses a hall situated in magnificent grounds, although within a few minutes of the main station, capable of accommodating something like 3,000 people, and endowed into the bargain with exceptionally good acoustic properties.

* * *

Have you heard this motoring one yet? The driver of an Austin Seven came to the rescue of a lorry which was stuck on Reigate Hill (which really *is* a hill, northerners may be interested to learn, although situate in Surrey), and towed it to the top. The lorry driver thanked him, but remarked that there was copious black smoke coming out behind. "Heavens!" the motorist said, "I must have left my brakes on all the time!"

* * *

This one has no connection with the preceding one, but, so far as I am aware, it is new. Two aged actors of the old school met one day in the street, and, after exchanging greetings and inquiries, the one said regretfully to the other. "Ah, laddie, I fear your diction is no longer as pure as it used to be!" His friend shook his head. "My diction," he said, "is as good as ever. But to-day it happens that I have lent my teeth to a friend who has gone to see a manager about a juvenile lead."

* * *

Film captions are not as a rule remarkable for their wit, but there are occasional happy exceptions, the more remarkable for the company they keep. Such, for instance, is the statement that "When a man's wife reaches forty he often wishes he could change her for two twenties."

MARKSMAN.

Institute of British Foundrymen.

LEICESTER CONGRESS.—ANNUAL CONVENTION BANQUET.

There was a gathering of some 200 members and guests at the Annual Convention Dinner, which was held at the Oriental Hotel, Leicester, on Wednesday, June 13. The President was in the chair; and the guests included the Mayor of Leicester (Alderman J. Thomas), the Mayor of Loughborough (Mr. E. J. Fox), Mr. Charles Benion, J.P., Mr. H. Winterton (President of the Foundry Equipment and Supplies Association), Mr. J. G. Pearce (director of the British Cast-Iron Research Association), and Capt. Crewdson (deputy chairman, FOUNDRY TRADE JOURNAL).

Trade and Commerce of the City of Leicester.

The Loyal Toast having been duly honoured, MR. WESLEY LAMBERT (Senior Vice-President) in proposing the toast of "The Trade and Commerce of the City of Leicester," said it was an honour which he fully appreciated to be entrusted with that toast, which he was sure they would all heartily receive. He was certain he was voicing their feelings when he said they were delighted and honoured in having the Mayor and Mayoress of Leicester with them. They would support him also in the wish that on some future occasion, when that toast was being proposed and the Mayor had to respond, the mode of address of that gentleman would be "The Right Honourable The Lord Mayor of Leicester." (Applause.) The fact that the Mayor had to respond to the toast had somewhat awed him. It reminded him of an incident which occurred when the late Sir William Harcourt and Mr. Gladstone were at a public meeting together, from whom speeches were demanded. The former gentleman excused himself by saying that to mix wine with water was to spoil both, and as Mr. Gladstone was to supply the wine, he did not propose to offer the water. They, he was sure, were expecting to have the wine from the Mayor of Leicester. The only excuse he had for saying anything at all in support of that toast lay in the fact that a sip of water sometimes prepared the palate for good wine. (Applause.) He was more familiar with the name of that City than perhaps with that of any other Provincial City in the United Kingdom, by virtue of the fact that there was a financial gentleman who addressed almost daily to his wife letters bearing the postmark of Leicester. (Loud laughter.) That gentleman's intelligence department must be very much alive, because he had surprised what was a domestic secret, namely, that any surplus money after his own modest needs were met, was claimed as a perquisite by his wife. (Laughter.) He was particularly pleased to have the opportunity of proposing the toast because as a Londoner it gave him an opportunity of thanking both the hosiery and shoe trades of Leicester for their very worthy efforts towards creating a brighter London. (Loud laughter.) He was neither too young nor too old not to appreciate that effort, though he sometimes thought on certain unrehearsed occasions the silken hose of Leicester was in somewhat too much evidence. (Laughter.) He must plead ignorance because as a technical man he did not know the difference between trade and commerce, and his good friend on the left, on being asked, had suggested that they were both the same. He hoped that the prosperity which had hitherto been experienced by the City of Leicester and the county as a whole would continue, and that the trade and commerce of that ancient city, which he gathered had more industries of a different character than any other city in the United Kingdom, would maintain its good record in that respect.

Leicester's Many Activities.

THE MAYOR OF LEICESTER, after thanking them for the kind and courteous way in which they had received the toast, said Mr. Wesley Lambert seemed a bit uncertain as to the difference between trade and commerce. His definition of those terms was that the man who was in trade was the man who transformed and worked the raw material into the finished article. The commercial part of it was the part of the salesman and man who organised the sale and disposal of the finished article. The industries in Leicester were such that they were in a position to clothe the whole of the civilised world from head to foot. Their main industries were boots and hosiery, and, amongst other things, as had been hinted at, they produced silk stockings. He always said if a girl paid 10s. for a pair of silk stockings and could only show 9s. worth of them, she was disappointed. (Laughter.) Another thing they could be proud of was the fact that in such times of trade depression as they were going through, they never felt the pinch in Leicester like it had been felt in other industrial towns, owing to the large number of their industries. That was how it

MR. H. BUNTING, THE HONORARY CONVENTION SECRETARY.

was that the working classes in Leicester did not feel the pinch. They had less unemployment in Leicester than in any other city of its size in the Kingdom. He would guarantee that there was no man and woman present at that gathering who had seen a man, woman or child badly dressed in Leicester. There were organisations in Leicester which supplied the demands in cases of necessity or want or distress in any circumstances. Leicester, as to its civic and benevolent institutions, might rightly be described as the University of England. They had quite a number of iron-founders and large engineering works, whilst the largest hosiery factory in the world, and the largest shoe machinery works in the Kingdom were to be found in their city.

The Institute of British Foundrymen.

This toast was listed under the name of Sir Henry Fowler, K.B.E., LL.D., but unfortunately Sir Henry was unable to attend at the last moment, owing to an urgent engagement arising with the Ministry of Transport. In the circumstances Mr. E. J. Fox (President-elect of the National Federation of Iron and Steel Manufacturers) stepped into the breach.

MR. E. J. FOX, in proposing the toast, remarked that he was in a position of considerable difficulty. Their President had paid him the compliment of asking him to reply to the toast of "The Visitors," in conjunction with his Worship the Mayor of Loughborough, and he would make no secret of the fact that he had been at some little pains in preparing suitable things to say on that subject. However, all that had gone by the board, and the only consolation he was left with was that he had been able to relegate that duty to the Mayor of Loughborough. Passing from frivolous thoughts to serious thoughts, the toast he had the honour to propose of "The Institute of British Foundrymen," was indeed a toast of the greatest seriousness. He would ask them to travel with him for a few minutes in trying to analyse the position of their great iron industry. There were several in that room interested primarily on the side of producers of iron, a commodity of which the bulk of those in the room were consumers. He would just like to ask the question: "What is wrong with the iron industry in Great Britain?" It was an industry which was sometimes overshadowed by the industry of steel. But in point of fact, the iron industry, from almost every point of view, was of far greater importance, particularly from the employment point of view, than its cousin, the steel industry. The output of the iron industry in Great Britain measured by tons was somewhere about the same as the output of steel. But there was this big difference between the two: that for every ton of pig-iron produced somewhere between 6 and 7 tons of materials were mined, quarried or produced. In other words, they must multiply the output of pig-iron by 6½ or 7 to arrive at the importance of the industry from a national point of view.

A Sick Industry.

Having emphasised the importance of the industry to the country, he would ask what was the condition in which they found it to-day? In the first place only some 60 or 70 per cent. of the blast furnace capacity was operating. What was a good deal more serious was that the pig-iron production to-day was less than it was 50 years ago. When one carried one's mind back to the developments in the iron and steel trade which had taken place during the past half-century, they would realise how grave the position was when he told them they were actually smaller producers of that basic commodity than they were in 1880. Going back not quite so far as that, but going back to the pre-war year 1913, taking 100 as the standard of 1913, the output to-day was 71, so that they had dropped back nearly 30 points since the war. The output of Belgium instead of being 100 was 152, the Saar 131, Germany 122, U.S.A. 112, then Great Britain 71. The only consolation they were left with was in the knowledge that Russia was below them with 70, as against their 71, and Poland was below them with 63 as against 71. They could derive a little consolation from the knowledge that at last the authorities who were governing over them had realised that something had to be done to put their basic industries on to their feet again as an alternative to handing over the reins altogether to the Continent. He had missed one important point in asking the question what was wrong with the pig-iron producing industry. He had omitted to tell them that in point of fact pig-iron was being produced, and was available in Great Britain cheaper than in any country in the world outside India. (Applause.)

To answer the question what was wrong with the pig-iron producing industry, obviously there could only be one answer, namely, that the pig-iron producing industry required resuscitating, and required to be brought into real being again as well as its consumers. How to achieve that he did not know. Whether the remedy required was Protection or what it was, it was not for him to say, but he was convinced that most industries such as theirs, big employers of labour per unit of output produced, could not possibly compete, as they were attempting to do to-day, with the Continent, where the rates of wages were between half and two-thirds cheaper than the rates of wages they were paying in their own country. He had asked himself the question was there anything that the pig-iron producers could do to attempt to help

the pig-iron consumers. Two points he was going to refer to, without he hoped it being considered presumptuous on his part, were those in connection with the founding business.

Coke Ratios in Cupola Practice.

Although he was a pig-iron producer the interests he was associated with were big consumers of pig-iron, big re-melters of pig-iron, to the extent of some 6,000 tons per week. The first of those two points was this: In many cases a great deal more fuel was consumed in re-melting iron than was necessary. (Applause.) At Stanton they operated cupolas with a percentage of fusion coke from 6 to 7 per cent. per ton of metal re-melted, the normal being taken at somewhere about 10 per cent. He might say that 10 per cent. was good practice; but with the volume of iron they had to re-melt, with the particular class of commodity with which they were dealing, unless they did get to the lowest decimal point of efficiency, they would have the very greatest difficulty in competing against their rivals on the Continent. He could not help feeling that in that one direction there was room for economy. They need not look for any improvements by adopting any quack medicines, but all they need do was to follow the principles and practice which had been known for many years. As to the new patents which came to one from the Continent they had tried them out, but they had not made any money out of them. He felt the Institute was doing remarkably valuable work in the direction of investigating problems of a technical nature in connection with iron founding which only a few years ago were poorly thought of, but which then were being tackled on really scientific lines. The Institute was very much to be congratulated on what they had already done in that direction; and they should be encouraged to carry that issue of their work a good deal further.

Potentialities of Ordinary Iron.

His second point was directly linked up with their analytical and scientific work. He thought there was a great deal more money thrown away in iron founding on the assumption that expensive special irons were necessary than in point of fact was actually the case in practice. If one took any of the cheap good brands of Derbyshire iron, with the knowledge on which they prided themselves, one could get results from their cupolas which would in every respect compete against mixtures which had very largely in the past been made out of so-called special irons. Speaking on behalf of the pig-iron producers, he could say that they would welcome co-operation on technical lines between themselves and the metallurgists and foundry managers. If that co-operation were a little bit more intimate and a little bit more extensive, he could not help feeling that they would succeed in aiding them to produce what after all was the only thing they were aiming at producing, namely, their commodities at the cheapest possible price. Should anybody think he had taken unfair advantage of their kindness in asking him to speak, he would just remind them of that old and very true saying: That when a man got to the age when he was no longer able to set bad examples he invariably turned round and started to teach others. (Applause.) He gave them the toast, coupling with it the name of their esteemed President, Mr. Russell.

Pig-Iron to Analysis.

The PRESIDENT, in responding, was very relieved to find that Mr. Fox did not expect him to tell them what was wrong with the pig-iron industry. They were, as big users of fuel, all glad to hear what had been imparted to those who went to the Stanton Ironworks concerning the remarkable results which had been achieved there as regards fuel consumption. Mr. Wilson, the foundry manager of Stanton, gave a Paper at Sheffield last year on that subject, and it might interest them to know that Mr. Wilson had told them that afternoon that he gave that Paper a year too soon, because he had achieved very much more since than he had achieved when he read the Paper. He threw that out as a suggestion to the London Branch as being a suitable subject for one of next year's Papers. With regard to Mr. Fox's remarks as to the use of the cheap Derbyshire iron as against the use of certain special irons, they might spend a whole session discussing that subject: but if Mr. Fox could persuade his fellow iron-masters to supply them with pig-iron of a known silicon content, instead of calling it No. 1, No. 2, No. 3, and No. 4 brand, he might find that the demand for his iron went up very considerably at small expense to himself. (Applause.)

If any Institute should hold an annual function, it should be the Institute of British Foundrymen. Their members were scattered all over Great Britain. They had a branch in every important industrial area, and each of those branches was complete with its own President, Council, membership list, and funds, and was quite capable of conducting its own affairs. Unless the representatives of the various Branches met together in conference once every year, there was grave risk of the programmes of the branches becoming parochial and narrow, thus hindering very much the development of the intellectual welfare of their members, which was the first item in their constitution.

Improved Quality Castings Available.

Considerable progress had been made in the production of castings of all sorts and sizes during the last few years. There had been a particularly big spurt owing to the more rigid specification introduced during the war, but he was sure that they would all agree that there was still a very wide field for the use of castings—he was not referring necessarily to iron or to steel, but to non-ferrous and white metal castings—if only they could get a higher quality still. He believed the most likely way in which that could be developed was by the exchange and interchange of ideas in their branch meetings and at their annual conventions. Every section of the industry, whether it was the grey-iron manufacture, steel manufacture, or non-ferrous manufacture, had its own peculiar problems, some of them being particularly applicable to the whole industry and not to a section only. He was thinking, for instance, of the non-ferrous industry, which had to use a considerable proportion of very expensive metals. If the world demand reached anything like normal, or increased in a normal way, it appeared to him that they would be forced to seek for substitutes for some of these metals. In addition to the problems peculiar to each section of the industry, there were many problems which were common to all of them, which could certainly be solved at meetings of the Branches or of the Convention. The Institute could claim that much of the success that had already been achieved in improving the quality and quantity production of castings of all grades was due to the work it had already done.

He was very pleased that next year he was to be followed by a President so well known in the non-ferrous world. (Applause.) Their membership predominated in grey-iron founders, and there was a risk of their getting too much of the various irons, including malleable iron, in their programmes, so tending to overlook the important non-ferrous section. With a President coming along who was almost entirely devoted to the non-ferrous section, he thought that side would receive more attention in the future.

A National Examination.

In his presidential address, he had referred to the development with which the Institute was faced. The first of these was the reframing of the membership classification in such a way that the recipient of an award would be recognised as a fully-qualified foundryman capable of taking his place in any executive position in a foundry. The second point was the organisation of national examinations. Considerable progress had been made (rather more than some members realised), in organising foundry classes up and down the country, but as these schools of technology could only organise their own local examinations, prepare their own papers, and issue their own awards and certificates, naturally those certificates had very little value outside their own areas. The Council, in its wisdom, had decided that it was to the benefit of the Institute to try and organise a national examination under some central body.

One question which had come much to the fore in connection with papers at the Institute was the question of costing. In discussing foundry costing, he was fully aware that they were on the border line of their constitution, but one could not have a healthy industry unless their members knew what their products cost to produce. (Hear, hear.) He had been surprised, in discussing that matter with members up and down the country, at the infinite variety of costing methods. The surprising thing was, that no matter what method was used one only reached the same result. Well might the foundryman of the old school say: "Let me have a look at the pattern, and I will tell you what the selling price is." Unfortunately, many of them were not so gifted, with disastrous results to the trade. He hoped that that question, after being thoroughly ventilated in the Institute, would be taken up by the employers' associations (which were the appropriate body to handle it), and would be followed right through to a successful issue.

Inquests.

Frequently, they were advised that one of the most profitable ways in which a foundryman could educate himself was to hold an inquest upon his scrap castings. He was very much struck with one instance of peculiar verdicts given by a coroner in his reminiscences. A body had been found in an open field, and there was considerable doubt whether the death could be ascribed to homicide or lightning. The jury returned a verdict of "death due to a visitation of God under suspicious circumstances"—(laughter)—which was rather an apt verdict for many of the inquests they had to hold. Some of these inquests were held owing to the fact that the moulder employed on a particular job had suffered from syncopated heart. He had been told by specialists that "syncopated heart" was caused by erratic movements from "bar to bar." (Laughter.)

He felt that whatever honour he had received in being appointed as President was due more to his Branch than to himself, and he was very proud of his Branch. They were so keen on that Conference that they had got their programme ready before the Sheffield Conference had begun, and it might interest them to know that their programme of fifteen months' ago was being rigidly adhered to with the omission of one detail only.

Organising Officials Thanked.

They must excuse him making one or two special references to members of his Branch. The Council had been wonderfully enthusiastic, and he hoped that the arrangements they had made had been found to be adequate. (Applause.) The team spirit shown by the Council had been really amazing. Out of a Council of 24, they had never less than 18 or 20 present, and they had held a meeting every month for months. There were four members of the Council to whom he must particularly refer. The first was their old friend, Mr. Pemberton. Mr. Pemberton was the senior elected member on the Institute Council. He was the first secretary of the East Midland Branch, which was formed after the Leicester Branch had been absorbed by the East Midland Branch. It was his own fault that, years ago, he was not their President, but he (Mr. Russell) was particularly glad he was not, because they had him as Branch President when the Conference was meeting in Leicester. He had been a driving force in programme-building, and they could not satisfy him until they had everything cut and dried. The next member he must refer to was their old friend, Mr. Bunting, who had acted so well as the hon. convention secretary. He was the senior branch secretary in the Institute. He had held that office far longer than any other branch secretary in the area. (Loud applause.) Mr. Bunting was a glutton for work. No matter how much work was given him, it would be carried through promptly and efficiently. He also desired to mention Mr. H. H. Moore, whom he looked upon as the stalwart of their Branch. (Applause.) In the East Midland area they had not always been able to get along swimmingly, but whenever Mr. Moore came into the committee room with his confident smile and cheery optimism, all their difficulties

vanished. Mr. Moore was amazingly justified in his confidence, but they had not felt like that until they had Mr. Moore's assistance behind them. As Treasurer of the Convention Fund, his success had really been astonishing. Lastly, he must refer to his brother, Philip, who had been his right-hand man throughout the Convention. They would realise that, in the East Midland Area, with their President and Secretary living in Derby, there had been an enormous amount of detailed work to do in Leicester. His brother started to collect all the material for the handbook, and other printed matter. He had been putting in full time for the last ten days in detail work in connection with the Convention. (Applause.)

He would conclude with a simile borrowed from the Rev. "Dick" Sheppard in his wireless address which was broadcast the other evening. After addressing his listeners, he ended up by saying that he was fully aware that many of them could be considered as buttresses of the Church, but not pillars. He then explained that a buttress always remained outside. They had a big fabric to build up in the Institute of British Foundrymen, but he was quite sure that their members would not be buttresses, but would be prepared to be pillars. (Applause.)

The Guests.

MR. SYDNEY A. GIMSON (Past-President) desired to use the word "Guests" in rather a bigger sense than intended on the toast list, and say what a great delight it had been to him to meet the whole of the foundry people in Leicester for the Conference. It had been a great delight to him that the Conference had been once more held in Leicester. In the old days he was then occupying the position so capably and so charmingly filled that evening by his old friend, Mr. Russell. (Applause.) One missed the faces of many good friends; but they had the satisfaction of feeling that those they missed did very good work in the time they were with them, and were not unprepared to pass on. He found as one got older that it was a good deal more difficult to remember things and faces accurately, and he was a bit like the old lady in the poem which ran:—

"There was an old lady of Sheen
Whose musical ear was not keen,
She said: It is odd
That I cannot tell God,
Save the weasel from Pop goes the Queen."

(Loud laughter.) He wondered sometimes what was the origin of such toasts as these, and he was a little bit inclined to think it was keeping in existence one of the old superstitions of pouring out libations to the gods, so that one could get their friendly interest. They were all delighted to see their guests, and to wish to do them honour. He had prepared something to say about Sir Henry Fowler, and they were all very sorry indeed that he was not there, as he would have been a most distinguished guest. They all knew the great work he had done on the Midland Railway. They were very proud in that part of the country of the Midland Railway. Among the guests there were two Mayors, the Mayor of Leicester and the Mayor of Loughborough, the latter of whom was to reply to that toast. Mayors were very important people. They were the first citizens of their towns during their year of office; and naturally every Mayor was jealous for the reputation of his own town. Therefore, he had to tread warily: if he said too much about Loughborough he would be in trouble with the Mayor of Leicester, so he would only say that the towns of Leicester and Loughborough were the two most important towns in the country. (Laughter.) They were very much indebted to Loughborough in that Loughborough possessed one of the finest Schools of Engineering in the country. It was experimental to a great extent, but he believed it was succeeding. In industry or in education, or whatever it was, if one were not prepared to try big and important experiments, one would never get on. It was the most important experiment attempted in Loughborough, and was being watched by the engineering industry all over the country with the greatest possible interest. Leicester wanted a head of its School of Technology, so it went and secured the head of the Loughborough Engineering Department; but he was sure Loughborough did not mind the loss, because the head of their Technical School, Dr. Schofield, was one of the finest engineers engaged in the education of the country. (Applause.) He need not say very much about Mr. Moss himself. Everybody knew the Mosses of Loughborough, and how much they were respected in that town. He might mention that it had been pressed upon him to tell them how much they were indebted for the very kind way in which they had been received at the Stanton Works, and he hoped that message would be carried there by Mr. Fox. The second speaker to reply to the toast was their good friend, Mr. Charles Benion, who was the Chairman of the British United Shoe Machinery Company, Limited. Since he came there and joined the little firm of Merry & Benion up to the day when he became head of the great Corporation, the British United Shoe Machinery Company, Mr. Benion had always served Leicester well, and had now become one of its most respected and important citizens.

A Basic Industry.

THE MAYOR OF LOUGHBOROUGH (COUNCILLOR ALAN MOSS), in responding, was very pleased to thank the Institute because he had partaken of their hospitality and had spent a delightful evening on one previous occasion. He thanked them not only on behalf of the guests, but particularly on his own behalf for that special evening at the same time as he thanked them for their hospitality that night. He was of the impression as a layman that the public generally knew too little of the working of the Institute of Foundrymen generally. With some wonderful and beautiful exceptions, their products did not appear to the layman as what one might call the finished article, but the fact remained that they were the foundation of all mechanical devices and contrivances, which was tantamount to saying that they were of vital import to everything they used, wore, ate or travelled with. In that mechanical age everything was done by machines, and the foundryman's work was the foundation of all these machines. Like other foundations, they were not very often seen and very seldom talked about, unless they failed. But the fact still remained that they were of paramount importance. In thanking the Institute on behalf of the guests for its hospitality he thought it was their duty also to thank them for the work they were doing in their Institute. They had placed before them high ideals in maintaining and improving the high standard of excellence which England held in all mechanical work. He wished them every prosperity and every encouragement in their work.

Engineers Should Buy, Not Make, Castings.

MR. CHARLES BENION, J.P., said it gave him great pleasure to have that unexpected opportunity of replying to the toast. He was not a foundryman, but he had been one many years ago. He might say that he was a friend of foundrymen, because he was a large consumer of castings. Perhaps he might be forgiven if he touched upon a somewhat personal matter in expressing the deep pleasure it gave him at seeing Mr. Russell in the position he was occupying as President. Before Mr. Russell was born he was associated with his father and his grandfather in business, so that he could say he knew the whole family. That experience had led him to appreciate the progress which ironfounding in that city had made; and the admirable manner in which Mr. Russell had studied his profession, and the way he had presided over the conference on that occasion. (Applause.) So long as the Institute of British Foundrymen could command presidents as earnest as Mr. Russell was, they would do good work. Much had been said about the development in ironfounding. No one knew that development better than he did. He was in charge of a foundry when he was 23; and he had further experience in acquiring and managing another foundry, only to give it up because he came to the conclusion that a man could not attend to a foundry unless he made it his sole study in business. If a man were capable of running a foundry he was capable of running it for himself and not for anybody else. He did not believe in a man running an engineering shop and running a foundry. He came to that decision many years ago. He had had many tempting offers to go into the foundry business again but he had always declined them. It was better and cheaper for them to get the experience of those who had made a life-long study of the problem than to go into the foundry business themselves. Years ago in designing a machine one made the castings as simple as possible: but to-day, with the idea of making the working as simple as possible, every engineer was making the castings as complicated as possible. He must say the foundrymen had risen to the occasion. There were castings being made to-day which engineers and foundrymen in his early days would never have thought could have been made, and it was all for the benefit of the industry. (Applause.)

During the evening the lady members and visitors were each presented by the Convention Committee with a pair of Leicester-made silk stockings as a souvenir of the occasion.

The proceedings concluded with a dance, which lasted until the small hours of the morning.

List of Members Attending the Conference.

A. Allen (Birmingham), F. Allan (Sunderland), T. Fearnley Allen (Birmingham), G. A. Allin (Derby), Major Athey (West Bromwich).

P. T. Bailey (Dronfield), A. G. Barker (Doncaster), J. P. Bayley (Newport), H. J. Beck (Derby), A. S. Beech (London), H. H. Beresford (Staveley, near Sheffield), R. P. Bethell (Birmingham), J. Bevins (Ulverston), C. W. Bigg (Derby), J. S. Birchall (Rochdale), J. B. Bird (Birmingham), E. Blackburn (Derby), C. Blades (Leicester), F. Bloor (Derby), F. J. Boam (Leicester), E. M. Boote (Coventry), W. H. Bound (Middlesbrough), G. Buchanan (Bilston), R. Buckland (Derby), W. D. Bullows (Birmingham), G. M. Bulwer (Derby), H. Bunting (Derby), G. R. Buckley (Sheffield), K. M. Burder (Loughborough), F. Burgess (Leicester), F. G. Butters (Ilkeston).

J. Cameron, Past President (Kirkintilloch), H. D. Campbell (Glasgow), E. A. Carlisle (Sheffield), G. C. Castle (Sheffield), A. S. Clarke (Loughborough), H. F. Coggan (Halifax), C. W. Coleman (London), M. T. Cooper (London), J. H. Cooper (Darlington), F. J. Cook (Past-President) (Birmingham), Guy Corrie (London), J. E. Cox (Ilkeston), F. Cramb (Bath), F. J. Cree (Peterborough), M. H. Curnow (West Bromwich), A. Campion (Glasgow).

D. Dalrymple (Birmingham), A. B. Day (Dronfield), W. A. Dawkins (Bilston), J. K. N. Davies (Luton), J. Davenport (Leyland), V. Delport (London), L. B. Derry (Yeovil), H. C. Dews (London), W. G. Dobson (London), W. Dorran (London), E. Doughty (Manchester), J. Durrans (Penistone), G. Duguid (London).

G. Edgington (Chesterfield), E. Edwards (Cheltenham), J. Ellis (Past-President) (London), J. Emmott (Sheffield), W. T. Evans (Derby), Dr. A. B. Everest (Birmingham).

V. C. Faulkner (Past-President) (London), H. Firth (Sheffield), W. J. Flavell (West Bromwich), S. W. B. Flavell (Leamington), P. Flavell (Leamington), G. E. France (Halifax), H. Forrest (Bradford), F. H. Fond (Leicester), C. Fontaine (Newport), J. Feasey (Lincoln).

B. Gale (Nottingham), T. H. Gameson (Birmingham), J. W. Gardom (Dunstable), A. J. Gibson (Derby), F. Gill (Nottingham), S. A. Gimson (Past-President) (Leicester), J. T. Goodwin (Ex-President) (Chesterfield), T. Goodwin (Loughborough), G. Grant (Loughborough).

D. Hancock (Derby), W. Hammond (Syston), R. S. Harris (Dronfield), R. R. Hargraves (Manchester), A. Harley (Coventry), W. Hallam (Leicester), E. D. Hall (Sheffield), S. Hadfield (Leicester), A. Hares (Bristol), F. Harper (Stockton-on-Tees), L. Hearnshaw (Chesterfield), H. J. S. Hilton (Derby), B. Hird (Newport), J. Hird (Birmingham), W. Hird (Bingley, Yorks.), W. Holland (Manchester), G. E. Hider (Torquay), A. S. Hider (Torquay), J. Hogg (Burnley), A. Hodgson (Manchester), A. E. Holmes (Loughborough), G. Holland (Loughborough), W. A. Homer (Walsall), R. E. Hoy (Walsall), J. R. Hyde (Sheffield), E. J. L. Howard (Manchester), J. E. Hurst (Sheffield).

J. E. Jadoul (Manchester), J. R. Jarney (Manchester), K. S. Jewson (Dereham), V. Jobson (Derby), W. Jolley (Manchester).

C. H. Kain (Braintree), R. W. Kemlo (Manchester), J. Kerfoot (Loughborough), T. Kershaw (Leicester), E. G. King (London).

W. B. Lake (Braintree), J. Laing (Bedford), W. Lambert (Vice-President), London, G. Lillie (Rowlands Gill), S. Lewis (Derby), H. Limbert (Loughborough), A. Logan (Newcastle-on-Tyne), E. Longden (Manchester), C. R. Loxton (Leeds), H. Lowe (Leicester), G. T. Lunt (Kingswinford), J. Lucas (Loughborough).

T. Makemson (General Secretary), J. Masters (Shrewsbury), W. J. McCulloch (Glasgow), T. McFarlane (Horsehay), T. McGrah (Wolverhampton), D. W. Maddock (Wellington), H. C. Marshall (London), T. W. Markland (Bolton), J. F. Measures (Leicester), H. Milner (Manchester), R. A. Miles (Manchester), W. J. Molineaux (Gateshead), H. H. Moore (Loughborough), G. Morran (West Bromwich).

F. J. Neath (Birmingham), Dr. A. L. Norbury (Birmingham), E. Northan (Sheffield), Hon. J. M. W. North (Chesterfield).

G. Offiler (Sheffield), W. O'Keefe (Birmingham), W. Olsen (Hull), R. Orme (Leicester), H. Oswin (Leicester).

V. D. Parord (Leicester), W. I. Pateman (Luton), C. S. Pearn (Leicester), J. G. Pearce (Birmingham), A. E. Pearce (Derby), W. C. Perry (Leicester), F. Pedge (Leicester), H. Pemberton (Derby), H. Phillips (Wednesday), W. H. Poole (Keighley), R. E. Pochin (Leicester), J. S. G. Primrose (Manchester), T. F. Procter (Glasgow).

H. P. Radford (Leicester), N. D. Ridsdale (Middlesbrough), R. Ritchie (Middlesbrough), J. Robinson (Calcutta), N. Robson (Braintree), W. Roxburgh (Rugby), F. Russell (Worksop), W. S. Russell (Leicester), P. A. Russell (Leicester), S. H. Russell (President) (Leicester), S. P. Russell (Leicester), S. Russell (Leicester), G. Russell (Leicester), A. J. Richman (Ipswich).

H. V. Sanders (Ipswich), A. Scholes (Ipswich), J. Shaw (Southsea), D. Sharp (Glasgow), R. J. Shaw (Monkseaton), H. Shillitoe (London), F. A. Shirt (Sheffield), J. W. Simm (Monkseaton), H. Simpson (Dawley, Salop), J. A. Smeaton (London), C. R. Smith (Wolverhampton), W. H. Smith (Derby), W. F. Smith (Derby), A. B. Smith (Wolverhampton), T. Spiers (Leicester), W. Street (Loughborough), E. Stevenson (Nottingham), A. Sutcliffe (Bolton).

G. Taite (Lutterworth), C. M. Tate (Burnley), W. G. Tate (Burnley), W. J. Tarrant (Poole), L. Tibbenham (Stowmarket), A. Tompkin (Leicester), S. Tompkin (Birmingham), S. J. Tompkins (Birmingham), F. Tunnicliffe (Derby).

V. E. Upton.

R. C. Waddell (Glasgow), A. Warner (Derby), H. E. Warner (Manchester), R. Watson (Rugby), F. J. Wares (Peterborough), J. H. Weathen (Newcastle), W. West (Leyland), A. J. Ward (Sheffield), E. A. Webb (Leicester), E. Wharton (Chesterfield), H. Wild (Loughborough), T. Wilkinson (Middlesbrough), C. H. V. Wilson (London), F. P. Wilson (Vice-President) (Middlesbrough), P. H. Wilson (Nottingham), D. S. Wintersgill (Leeds), W. R. Wintle (Chesterfield), B. Winterton (Chesterfield), H. Winterton (Glasgow), D. H. Wood (Birmingham), A. S. Worcester (Huddersfield), W. A. Wright (Huddersfield), A. Whiteley (Sheffield).

G. A. Vaughan (Derby), F. Varney (Derby).

R. Yates (Accrington).

Souvenir Photographs.

Some really fine photographs of the visitors to the Leicester Conference, taken at the Carillon Tower and Mr. Gimson's cottage, examples of which have appeared in our columns, are obtainable at the cost of 2s. each from Mr. P. A. Russell, B.Sc., Messrs. S. Russell & Sons, Bath Lane, Leicester.

MESSRS. JOSEPH KAYE & SONS, LIMITED, Leeds, have received an order for 800 of their patent valve oil-feeders from Leyland Motors, Limited.

American Iron and Steel Institute.*

The 33rd general meeting of the American Iron and Steel Institute was held on May 25 in New York, under the presidency of Mr. Charles M. Schwab.

In his Presidential address MR. SCHWAB touched upon the importance of a change in the existing laws as a step towards eliminating economic waste, and recommended the appointment of a committee of steel experts to study the problem and make the necessary representations to the authorities. He expressed the view that the steel industry had gone as far as could be expected in the reduction of costs, and that, under present competitive conditions, its low margin of profit was not conducive to sustained national prosperity. There remained a possibility of reducing costs further by eliminating wasteful methods of distribution. Cross hauling of steel was one of the most glaring examples of waste in distribution. It was obviously in the public interest that every industry should be conducted upon the most economical basis possible. It was equally important that the public interest should at all times be protected against agreements affecting prices or trade conditions which might themselves become a burden upon the public. Surely between these two horns of the dilemma there must be middle ground which would be in the interest alike of the manufacturer and the consumer, and of national prosperity as a whole.

No one could view the steel industry to-day without reaching the conclusion that this fundamental American business was apparently content with a profit on its investment amounting to little more than the interest one could earn from a savings-bank deposit. Here was a business which provided the essential elements of practically all industrial, manufacturing and transportation effort. It paid its workers higher wages than were paid in almost any other line of manufacture. In manufacturing efficiency it was second to no other industry in the world. Capital investment in the steel business was greater to-day than it ever was. The output reached record volume. He did not think, however, that the country intended to demand the service they were rendering for the small return which the steel industry was currently receiving. He did not mean to imply that the steel industry expected large returns. But it had a right to expect, and it was in the public interest, that enough should be earned to provide for the expansion, modernisation, and development of the plants which the country's ever-growing needs constantly required.

The total investment in the steel industry of the country was approximately five billion dollars (5,000,000,000), of which approximately one and one-half billion dollars had been added during the last 14 years. The rate of return upon this investment of five billion dollars had been approximately 5 per cent., and virtually no return at all had been earned upon the additional one and one-half billion dollars last invested, the total earnings in the industry to-day being only slightly more than they were 15 years ago, before the additional investment in plant had been made. The rate of return upon investment in their industry was almost, if not quite, the lowest return earned in any of the principal manufacturing industries.

Assuming general acceptance of the plea that the rate of return in the steel industry was inadequate, what remedies could be suggested. The two most obvious were, of course, reductions in cost or an increase in prices. To the first suggestion he would say that the steel industry had already gone very far in reductions in cost, the experience of his own company showing a total reduction of $7.27 per ton in the average cost of production between 1923 and 1927.

Commenting on the economic losses through cross-hauling of steel, Mr. Schwab said:—It is manifestly uneconomic for a steel manufacturer in Chicago to consign 100,000 tons of steel to Pittsburgh at a time when a Pittsburgh manufacturer is sending a like quantity of like material from Pittsburgh to Chicago. The sales in each case must be made at prices prevailing in the districts where the steel is sold, and consequently the sale prices net less to the manufacturer in each case than they would have netted if the Chicago manufacturer had supplied the Chicago market and the Pittsburgh manufacturer the Pittsburgh market. This example is an extreme case which, in actual practice, probably seldom occurs, but is illustrative of cross-hauling which does occur in very large quantities from various districts. This is a problem in which the buyer of steel, as well as the producer, is, or should be, vitally interested. It must not be assumed that all of the cost of this cross-hauling is borne by the producer. It is obvious that there is an economic waste in permitting the cross-hauling to exist, and it should be obvious that this waste is paid for jointly, although perhaps indirectly, by the consumer as well as the producer of steel products.

Mr. Schwab asked the approval of the membership, which was given unanimously, of a change in plan regarding the Gary Memorial. In place of a commemorative tablet, it was now proposed to found an "Elbert H. Gary Medal," which would be to the American Institute what the Bessemer Medal was to the British Society, namely, an annual award to that person who had contributed most notable services to the iron and steel industry in any of its branches. A secondary medal in bronze was also approved, to be awarded in the name of the Institute to the author of the best Paper for a given year. Definite rules covering these awards were to be formulated.

British Institute to Meet in the States in 1932.

Mr. Schwab went on to state that an invitation to the Iron and Steel Institute of Great Britain to meet in the United States in 1932 (of which invitation he was the bearer on his recent visit) had been very warmly received. The invitation had been accepted, and the British Institute of Metals would meet in the States at the same time as the guests of the American Society of Mining and Metallurgical Engineers.

An amendment to the constitution of the Institute increasing the number of directors from 24 to 30 was unanimously carried. The six additional directors, however, have yet to be chosen. Mr. James A. Campbell (president, Youngstown Sheet & Tube Company, Youngstown) has succeeded Mr. Willis King (Jones & Laughlin Steel Corporation, Pittsburgh) as one of the Vice-Presidents of the Institute, Mr. King having been made an Honorary Vice-President.

At the banquet, held in the evening, Sir William Ellis (managing-director of John Brown & Company (England) paid tribute to American hospitality and engineering genius. He recalled that his firm had supplied the first steel rails to be laid between St. Louis and Kansas City. He concluded with a plea for still closer relations between the English-speaking countries.

* Based upon a report in "The Iron Age."

Engineering Exhibition at Cardiff.

The Council of the South Wales Institute of Engineers announce that the Seventh Annual Engineering Exhibition will be held under the Institute's auspices in the Drill Hall, Dumfries Place, Cardiff, from November 21 to December 1 next (both dates inclusive).

The Exhibition will be open daily from 2.30 to 8.30 p.m., and will embrace the following sections: Scientific, Measuring and Recording Instruments; Steam; Electrical; Mechanical; Workshop Appliances; Metallurgical; Marine; and General.

Applications for space, etc., in the Exhibition should be made before August 31 to Mr. Martin Price, Secretary, The South Wales Institute of Engineers, Park Place, Cardiff.

THE Polish cast-iron pipe industry is forming an export organisation, with the help of the Government. They are said to be granting 100 days credit to foreign buyers. Prices are less than pre-war, at which time Russia took 75 per cent. of the output as against 10 per cent. at present.

Iron Foundry Costing.*

By W. R. Wintle, F.C.W.A.

The subject of Costs, up to a few years ago, was not to any extent appreciated by the practical side of a manufacturing concern. This was owing, not so much to lack of interest in it, as to the inability to understand the nature and form of its makeup. The practical men in those days were not supposed to know anything about the £ s. d. of their shops' trading. They were concerned with output. Those days have gone. Every foreman, superintendent, and manager, is keenly alive in these days to the importance of knowing all they can about the shops they are endeavouring to run, and how much it is costing to run them.

There are many systems and practices in operation all over the country dealing perhaps with this most complex of all costing problems—the foundry. Complex, because, in a great many cases, the design of the place has of necessity had to fit in with a limited capital expenditure, and little thought also to the ultimate outcome of the putting down of a foundry, viz., its products.

On the other hand, there are foundries where every consideration has been given to the production, in separate bays, suitably equipped, of the light casting, the medium, and the heavy type of casting, and costing under these conditions certainly loses some of its complexity. Design then, plays a very important part not only in production, which is its primary object, but wherever method, thought, and science are blended, there also will the cost reveal the true value of the investment.

Cost systems have several uses, and it is not unusual to find in the design of them features which are prone to give more information to one side of the concern than the other. In the accounting or financial department, everything might be quite satisfactory. To the managing director, a little less detail here and there; to the estimating department, efficient recording only; while to the superintendent, foreman, and department manager, more and more detail is necessary. The shops undoubtedly want their data red hot, and will welcome any method that provides it. They naturally are not concerned with the higher and executive uses of the information. On the contrary, the higher officials do not want to be overwhelmed with so much detail, but want accurate results assembled in a form, the significance of which they can readily grasp. In fact, the higher the control, the more general becomes the type of information required, but incidentally the grouping and presentation of the facts must be clear and systematic.

One of the essentials lacking in a great many foundries to-day is the "standard cost." The standard cost of an article is either the known "former" cost, or what is the "pre-determined" cost. The form of this information should be so arranged that the actual cost of production can be set alongside as the work proceeds and should always be available to the foreman or superintendent.

In the foundry, as anywhere else, manufacture is the art of making changes in the condition of material by the application of labour and machinery. Involved in that brief statement are the elements of cost, "labour, material and establishment charges." Under these three items all the expense of a foundry must come.

Essential to the iron foundry in particular, are the main features of any cost system which is to be of practical value, and these should show first, *direct charges*, as:—The cost of the pattern shop, which is an allied department; the melting department or cupola cost; the moulding shop cost; the coremaking cost; the fettling and cleaning department; the smiths' shop; and the machining and fitting shop (if allied to the foundry).

Secondly, there are the *indirect charges*, such as:—Miscellaneous yard labour and general labour in the foundry; crane driving in the yards and foundry; and pattern carrying between departments.

The materials used, should show the consumption of those for the actual production of castings, such as:—Iron, sand, coal, coal-dust, stove-coke, manure, straw-ropes, blacking, plumbago, chaplets, sprigs, studs, core-vents, core oil, etc., and for the completion of any assembled work in the foundry, direct materials should also be shown, such as:—Jointing material, packing rings, forgings, and steel castings, etc.

Upkeep and Maintenance.—All items making up the running expenses of a foundry should be prominently shown. These include:—Gas for lighting and heating; electricity for lighting and power; steam generated for hydraulic power or crane services; water supply; oils, grease, waste and sundry stores; and box fitting.

Repairs and Replacements should be assembled under the principal items of plant, etc., such as:—Cranes, motors, lathes, moulding machines, blowers, tools and chains, loam mills and mixers, cupola, stoves, and buildings, etc. (See Form No. 6.)

Establishment Charges.

Each business must determine how much or how little the costs shall reveal under this heading, but the more important items are shown under that of "general expenses." Having laid down the particular headings of the information needed, it now will be necessary to follow the method of collection and the routine essential to distribute that information, so that the individual castings, or class of castings produced, may be fairly dealt with for selling purposes.

Various forms are detailed showing the compilation of the data collected, including the monthly cost account. In many foundries only a half-yearly account is considered necessary, but it is assumed here that a monthly cost account is prepared, for in competitive days such as these a month is quite long enough to lack knowledge of the results of one's trading, and little time enough to put right the wrongs which have accumulated. It will be worth while to understand, as the outline of the system proceeds, the part which the works in general plays in the building up of the cost, and the foundry in particular. The first of the routine items belonging to the works side of the system is the stocktaking.

Stocktaking.

Physical stocktaking is a matter of prime importance in a foundry. It has been argued that the general methods adopted are loose and carelessly undertaken; the result of which when seen in figures of materials consumed is merely a matter for scepticism. This need not be. A good foreman, and an equally good cost clerk, between them will arrive at conclusions regarding stocks however small or however large they may be, that will be sufficiently accurate as to make no violent differences in monthly comparisons.

All materials on hand on the 1st of each month, whether stored under cover or in the open yard, must be taken into stock, the record being actual weight where possible, and actual quantities if by count. Goods in transit, if the account is being paid in that month, should be added to the stock on the ground. The opposite method is to have returns rendered of everything used during the month and keep a book stock with a physical check at the end of every financial period. This is not sound in practice, because of the liability to render wrong returns and has been known in the case of more than one firm to leave them with large adverse balances to write off in consequence. The true value of their costs, therefore, is lost.

Purchases of Goods Inwards.

The clerk or store-keeper appointed must be held responsible for the receipt of all materials coming into the foundry or for the foundry. Invoices should only be passed on his signature. The date received is very important from a costing standpoint. All other information can be taken from the account itself, as to quantity, weight, price and amount, when once the invoice has been checked.

Wages and Time Recording.

More important, perhaps, than any other record, is that of the wages record. A competent clerk, conversant with foundry practice, regarding personnel and materials is most necessary. Whatever the system of payment, whether contract, piece work, bonus work, or day work, the need of accuracy in booking time cannot be overstressed. Especially where individual jobs are concerned is this a matter for careful supervision both on his part and on that of the foreman. A daily record is essential giving time spent; works order No.; job No.; and quantity made, etc.

As to systems of recording, that is a matter for individual taste and economy. One fact emerges very solidly. Whatever method be adopted, whether time-boards, time-clocks, or time-clerks, the original entry is the basis of all subsequent analysis, and therefore the best means of securing this, compatible with the expense involved, should be the deciding factor, remembering always that there is such a thing as the cost of costing.

Machinery in costing is playing to-day a very important part, and in quite a large number of modern works, where the employees are numbered from, say, 1,000 upwards, the old methods of time records and wages analysis are already considered obsolete. The Powers and Hollerith machines, electrically operated, are installed, and can deal with every day's time in such a way, that the original time booked, being transferred to cards by mean of punches, forms the basis of the weekly pay roll, cost analysis for class cost, job cost, order, or whatever information is required. The new method is undoubtedly costly to instal but undeniably accurate and economical in use.

A most important item of wages cost is that which represents time spent on repairs and maintenance. Too much care cannot be bestowed on the checking of this time, and inside the cost system should be the means of bringing together under the headings already indicated the total cost from all sources spent on repairs. The control of this expense is entirely in the foundry manager's hands, and, in every case where ordinary repairs are contemplated, usually the work is proceeded with only under his direct signature or other responsible official. Especially when times are bad and work is scarce and shops only partly employed will this item tend to increase out of all proportion to the usual figures, very often reflecting the labour which, not being able to book on productive orders, finds its way into the "Standing Orders" or "Repairs Account."

Statistical Records.

A daily charge sheet for the cupola should be prepared giving details of the various grades of iron used in pig, scrap, coke, limestone, etc., the number of charges, and the quantity of new scrap put on, as against own scrap produced previously (see Form No. 7). The previous day's weight of scrap produced by runners, risers, gates, spare metal, tackle, etc., should also be the subject of a further record, the information having a necessary bearing on the coke consumption per ton of iron melted, and also the loss in melting. A difficulty in doing this is often experienced, and especially in large foundries is this the case. Where the difficulty exists, the loss in melting is not a reliable figure unless it is pre-determined.

Tests can be taken over a period of a week or more to ascertain the loss by (1) keeping a strict record of all iron going into the cupola; (2) after the ladles are lined, weighing them; (3) filling the ladles from the cupola, skim them and reweigh.

* A Paper presented to the Leicester Convention of the Institute of British Foundrymen.

The difference between each day's weighing into and out of the cupola will represent under normal conditions a fair index to the loss in melting. One could not argue, of course, that the figure so found would be right for all time—much depending on the quality of pig and scrap being used. But assuming the tests covered several periods during the year, then the percentage could be used with reasonably accurate results.

FOUNDRY SUMMARY COST. *Month of* , 192 .

Saleable tons divisor: Tons.	Cwts.		Tons.	Cwts.	Qrs.	Lbs.	Percentage.
		Saleable castings					57
		Box parts					2
		Iron patterns					—
		Total saleable					59
		Waster castings					7
		Tackle and plant					18
		Runners, risers, heads, etc., etc.					10
		Total Cast					94 per cent.

	Tons.	Cwts.	Rate.	Amount. £ s. d.	Total. £ s. d.	Cost Per ton. s. d.	Total Cost Per ton. s. d.
(1) METAL.							
Foundry pig-iron							
Hematite pig-iron							
,, scrap							
Cold-blast iron							
Steel scrap							
Cast scrap (New)							
,, ,, (Own)							
Total			= 100 per cent.				
CREDIT FOR WASTERS, RUNNERS, RISERS, AND TACKLE							
(2) CUPOLA COST.—Cost per ton of iron melted.							
Wages							
Gannister							
Limestone							
Coke (cwts. per ton melted iron)							
Sundry stores, etc.							
Laboratory							
Repairs, etc., as per Schedule							
Suspense Account							
Depreciation							
Proportion of power, light, rates, etc.							
(3) MOULDING SHOP.							
Wages.—Moulding in dry sand							
,, ,, green sand							
,, ,, loam sand							
,, ,, by machines							
Indirect labour as per Schedule							
Repairs, etc., as per Schedule							
Suspense Account							
Depreciation							
Proportion of power, light, rates, etc.							
Materials used:—							
Sand							
Manure							
Blacking							
Plumbago							
Sprigs							
Coal dust							
Cow hair							
Sundry stores, etc.							
Pattern Shop direct Charges							
PERCENTAGE OF OVERHEAD EXPENSES TO DIRECT WAGES							
TOTAL PERCENTAGE							
(4) COREMAKING SHOP.							
Wages in Moulding Shop							
,, ,, Core Shop							
Indirect labour as per Schedule							
Repairs, etc., as per Schedule							
Suspense Account							
Depreciation							
Proportion of power, light, rates, etc.							
Materials used:—							
Sand							
Coal							
Coke							
Straw ropes							
Wood wool							
Core gum							
Core oil							
Rosin							
Wax wire							
Sundry stores, etc.							
PERCENTAGE OF OVERHEAD EXPENSE TO DIRECT WAGES							
TOTAL PERCENTAGE							

	Amount. £ s. d.	Total. £ s. d.	Cost per ton. s. d.	Total Cost per ton. s. d.
Brought forward				
(5) FETTLING AND CLEANING SHOP.				
Wages				
Indirect labour, as per Schedule				
Repairs, etc., as per Schedule				
Suspense Account				
Depreciation				
Proportion of power, light, rates, etc.				
Sundry materials and stores				
PERCENTAGE OF OVERHEAD EXPENSE TO DIRECT WAGES				
TOTAL PERCENTAGE				
(6) SMITH'S SHOP.				
Direct wages				
Coke				
Sundry stores				
Iron and steel				
Repairs, etc., as per Schedule				
Suspense Account				
Depreciation				
Proportion of power, light, rates, etc.				
PERCENTAGE OF OVERHEAD EXPENSE TO DIRECT WAGES				
TOTAL PERCENTAGE				
(7) GENERAL EXPENSE AND ESTABLISHMENT CHARGES:				
Salaries of Manager, Clerks and Officials				
Salaries of Salesmen and Expenses				
General Charges (i.e., Directors, Auditors, Law Charges, etc.)				
Telegrams, telephones, stationery, etc.				
PERCENTAGE OF GENERAL EXPENSE TO WHOLE OF DIRECT WAGES FOR FOUNDRY =				
TOTAL FOUNDRY COST £ FOR UNMACHINED CASTINGS.				
(8) MACHINE SHOP.				
Wages—machining direct to customers' orders				
Wages—fitting direct to customers' orders				
Wages on repair work for Foundry = to repairs Schedule				
Direct materials to customers' orders				
Establishment charges and overhead expense to customers' orders				
Establishment charges and overhead expense to repair work (to repairs Schedule)				
TOTAL FOUNDRY COST £, INCLUDING MACHINE SHOP				

STOCK AND PRODUCTION STATEMENT.	Tons. cwts. qrs. lbs.	Rate.	£ s. d.
Stock of castings at beginning of month			
Cost of good castings in current month			
Total			
Less castings in stock at end of month			
Cost of castings delivered during month			

FORM NO. 1.—FOUNDRY SUMMARY COST.

The cupola and production record becomes then a matter of routine with all the factors known essential to good management. Total input minus loss in melting will give total output, and total output minus weighing of saleable castings, wasters and sundry tackle will leave the balance representing the runners, risers, heads, metal over melted, etc. The value of knowing these figures depends on the use made of them. Coke consumption per ton of metal melted reflects on the quality being purchased. The loss in melting will likewise determine some relationship in the quality of scrap and pig purchased.

Another method is to ignore the total output of the cupola and only take the saleable weight of good castings, the wasters and the tackle, and apply a known loss in melting of, say, 6 per cent. The formula for an output of 100 tons would be $\frac{100 \times 100}{94}$. This will give the amount of metal melted, viz., 106 tons 8 cwt. approximately for the known output of 100 tons, in which case it is assumed that all other metal melted, representing runners, risers, etc., has been duly returned to the cupola and used over again. One can see readily that this is not so accurate as the former method.

Output.

The production record should be for every day's cast, with weights of every casting (after fettling) given, the number of castings made, the job number and works order number. Waste castings to be shown in a separate column, and the cause of waste shown.

Stores Issued.

The issue of materials used in moulding should wherever possible be made from a stores, and charged out on a "used" basis. This will facilitate weekly costing and will also be a check against goods inwards and stock-taking inventories. Other materials, such as sand, coal, coke, etc., must be estimated for any other period less than a month, when the stock book will give the necessary information. Oils, grease, waste, small tools, buckets, bellows, brushes, shovels, belting, riddles, etc., should all be charged against a stores issued ticket. A record of all material used by the smith in the foundry is also essential. The above is to a large extent the works side of the routine of costing. The following pages will deal with the procedure leading up to the final compilation of all the figures relating to one month's trading account.

The Stock Books.

The posting to the stock book of all materials which have been purchased and accounted for is the next step (see Form No. 8). The stock on hand at the beginning of the month is brought forward and entered up under each class of material, such as hematite pig, hematite scrap, foundry qualities, ordinary scrap, sand, coal, etc., etc. To these are added the amounts purchased as per accounts. The totals of stock and purchases are then made, and from these totals the stock on hand at the end of the month is deducted, leaving the balance "used." In the case of the iron this should approximately tally with the record issued from the foundry day by day when the total is aggregated.

Before taking the average prices as shown by the stock book, consideration must first be given to the state of the market, whether constant, rising, or falling. If a falling market, then the valuation of stocks should be at market prices and not purchase price.

Analysis of Wages.

The analysing of wages is a very important branch of costing procedure. Comparisons depend on its accuracy, and comparisons reveal many otherwise escaping facts. Under headings of "moulders (dry sand)"; "moulders (green sand)"; "moulders (loam)"; "coremakers," "fettlers" and "cleaners," "labour assisting moulders," "smiths and machinists," (where attached to the foundry) the direct labour cost is ascertained. In this process each job number is taken out; "cupola tenters" labour, handling materials to the cupola, unloading and stocking iron, and weighing in form another analysis.

The "indirect labour" is mostly composed of "labourers' wages," "mixing and milling sand," "metal carrying," "store-keeping," "cleaning windows," "cleaning up shops," "yard-crane drivers," "overhead-crane drivers," etc., etc. All these are analysed separately.

Repairs and Maintenance.

All classes of labour will be represented in this analysis. It is the usual practice for booking to be against "standing orders" or code numbers, as it is important for a manager to know, not only the total cost of repairs, but on what particular part of the foundry the repairs were carried out. Hence a set of code letters and numbers dealing with "buildings," "cranes," "lathes," "moulding machines," "core-turning machines," "loam mills," "cupola stoves," "compressors," "blowers," "electrical equipment," etc., etc., is required.

With the analysis evolved on the above lines, the week's wages bill will read as follows:—

	£ s. d.	%
Direct wages to manufacture ..		
Direct wages to cupola		
Indirect wages to general labour		
Indirect wages repairs and maintenance		
TOTAL		100%

The summary of wages will then be entered up each week under each job number, and all moulding and other grades of labour under their respective columns, which are totalled and balanced.

Purchases Analysis.

Apart from the purchases of iron, coal, sand, blacking, etc., to which reference has already been made, and for which stock accounts will be necessary, there are other purchases of quite a different kind, which all foundries will need and which are generally requisitioned for immediate use:—"Wheels for crane tracks," "ropes for cranes," "iron for tools," "woodwork for buildings," "bricks," "cement," and "repairs to electrical equipment," etc., etc.

The whole of the accounts relative to the foundry should be entered up in a suitable purchase book, with columns ruled to take stock accounts, repairs and maintenance accounts, etc. There will also be charges for power, lighting, heating, sundry supplies, etc., and these must be allocated to the proper columns.

Nominal Charges.—Where a foundry draws from another part of the works (internal trading), then charges will be received from those departments which are working for them, just in the same manner, and at prices based upon the open market where possible.

(To be continued.)

SCHEDULE FOR DISTRIBUTION OF POWER, LIGHT, HEAT AND WATER.

Month.	Electricity.	Lighting Cost.	Heating Cost.	Water Cost.	Total.	Departments of Foundry. Cupola.	Moulding Shops.	Core Shops.	Fettling Shops.	Smiths' Shop.	Machine Shop.	
Proportion	Where a steady ratio is maintained.					20 per cent.	15 per cent.	5 per cent.	10 per cent.	3 per cent.	47 per cent.	Figures to illustrate only.
January ..	110	25	10	5	150	£30	22½	7½	15	4½	70½	
February	85	23	10	5	123	£24	19	6	13	3¾	57¼	
March ..												
April ..												
May ..												
June ..												
July ..												
August ..												
September												
October ..												
November												
December												

FORM NO 2.—SCHEDULE FOR DISTRIBUTION OF POWER, LIGHT, HEAT AND WATER COSTS WHERE DIRECT-METERING IS NOT AVAILABLE.

DISTRIBUTION OF LOCAL RATES AND FIRE INSURANCE.

	Estimated Rateable Value. Buildings and Equipment.	Per cent.	Rates.	Fire Insurance.	Total.
	£		£ s. d.	£ s. d.	£ s. d.
Cupola Department	3,000	3.15	1 3 1	0 1 11	1 5 0
Moulding Shop	35,000	36.85	13 11 0	1 2 0	14 13 0
Core Shop	10,000	10.52	3 17 11	0 6 6	4 4 5
Fettling Shop	1,000	1.06	0 7 7	0 0 8	0 8 3
Smiths' Shop	1,000	1.06	0 7 7	0 0 8	0 8 3
Machine Shop	45,000	47.36	17 8 4	1 9 7	18 17 11
Total	95,000	100.00	36 15 6 per month (for 6 months)	3 1 4 per month (for 12 months)	39 16 10 per month

FORM NO. 3.—DISTRIBUTION OF LOCAL RATES AND FIRE INSURANCE.

Catalogues Received.

Swedish Iron and Steel.—Messrs. Ernst B. Westman, Limited, of 39, Lombard Street, London, have prepared an interesting, well illustrated booklet on Swedish charcoal iron and steel. It outlines the properties of these materials in general, and no reference is made to any particular brand. There are included a number of useful tables as an appendix. The illustrations of wrought iron are particularly good, whilst the general get up is commendable.

Drying Stoves.—An advance leaflet sent to us by The Foundry & Engineering Company, of Sandwell Road, West Bromwich, illustrates and describes the "Acme" mould and core-drying stove. It is of the forced draught type, and admits of a certain amount of elasticity in design and construction. Whilst sliding doors are recommended, the hinged variety are also installed. Moreover, where conditions admit, existing stoves are modified to incorporate the Acme system.

Malleable Castings.*

By W. T. Evans (Member) and A. E. Peace (Member).

(*Continued from page* 457.)

The Question of Even Sections.

From the foregoing description of the annealing processes of both types of malleable the outstanding features should be apparent. As mentioned previously, castings to be made from either material should be as far as possible of even sections, but for an entirely different reason in each case. In white-heart the sections should be even because of the impossibility of annealing the thicker section as successfully as the thinner one. With black-heart the question of thickness does not affect annealing. The only trouble that can accrue from a thick section is that which is common to the use of border-line irons. The mass effect so governs the rate of solidification and cooling that grey fractures are easily obtained unless special precautions are taken. The common methods adopted to safeguard against this effect are the application of chills, use of red sand, or shot-sand cores. But on heavy sections the result cannot always be achieved, as if large top feeders are necessary they may result in greyness. Grey fractures, in either type of malleable, are useless for the annealed product, as the presence of primary graphite ruins any claims to malleability. There is no limit to the section which can be completely annealed in one cycle by the black-heart process, a point demonstrated by the micrographs taken from a bar of 3 in. dia., cast from a normal heat, which was annealed, once, under ordinary conditions, as shown by the chart, Fig. 17. Table VII shows the analyses from different points, and Fig. 14A shows a photograph of a fracture, Fig. 15 the micrographs. It will be seen from the latter that there is no combined carbon apparent remaining in any portion of the bars, and that the only difference in structure between the edge and the centre is the slightly larger carbon-nodules and size of ferrite grains, which has affected the quality, as shown by the physical tests in Table VIII. It should be clearly understood that the authors do not advocate 3 in. sections, but are desirous of proving that black-heart of such section can be completely annealed by the ordinary methods.

Illustrations are shown in Fig. 16 and analyses in Table IX of a 2½-in. dia. bar made in white-heart which has had one anneal and has had no special treatment. It will be seen from the amount of free cementite which is present practically right through the sample that the annealing has penetrated a very short distance only. Such material is quite strong but possesses little ductility, and, except in the skin, is not readily machined. It would be impossible to cut test bars from this specimen which would fulfil the B.E.S.A. white-heart specification. It will be seen from this example that white-heart castings should be made of minimum section.

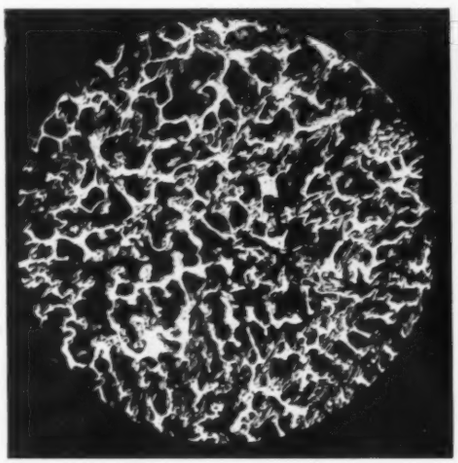


Fig. 15A.—3-in. diam. Black-Heart Block, before Annealing. Etched × 50.

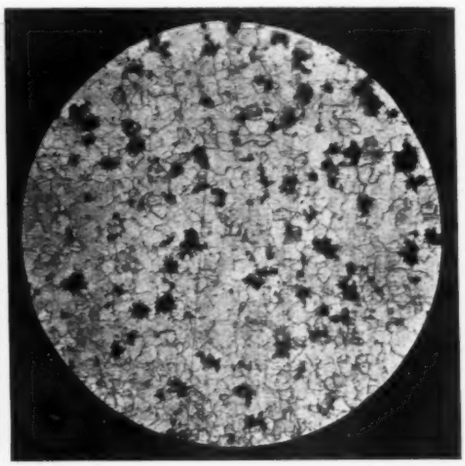


Fig. 15B.—3-in. diam. Black-Heart Block. Annealed. ¼-in. from edge. Etched × 50.

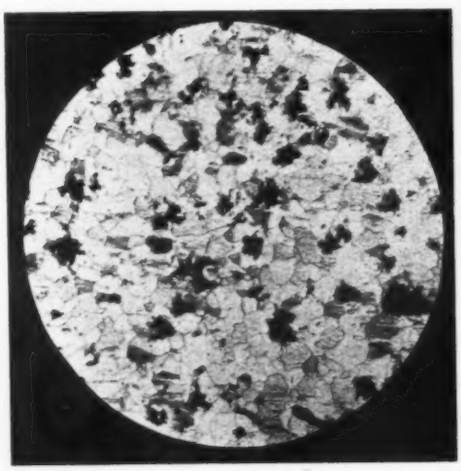


Fig. 15C.—3-in. diam. Black-Heart Block. Annealed. ¾-in. from edge. Etched × 50.

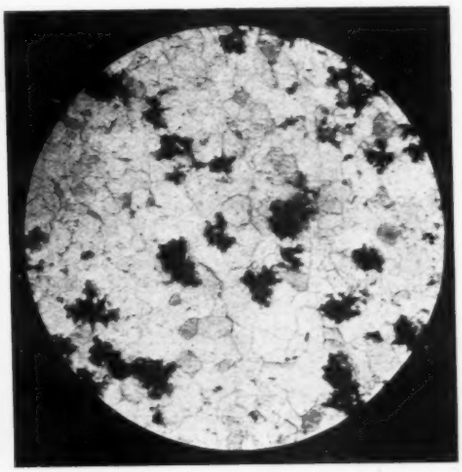


Fig. 15D.—3-in. diam. Black-Heart Block. Annealed. Centre. Etched × 50.

Table VII.—*Analyses of the Hard and Annealed 3 in. Diam. Black-Heart Block.*

	T.C.	Gr. C.	C.C.	Si.	Mn.	S.	P.	Cr.
Hard Iron.	2.33	nil.	2.33	0.848	0.258	0.036	0.097	0.006
Annealed ¼ in. from edge ..	2.20	2.15	0.05	0.894	0.277	0.050	0.106	0.006
Annealed ¾ in. from edge ..	2.25	2.19	0.06	0.892	0.277	0.052	0.104	0.006
Centre	2.29	2.23	0.06	0.894	0.274	0.052	0.105	0.006

Table VIII.—*Physical Properties of Bars Cut from 3 in. Diam. Black-Heart Block.*

	M. S. Tons per Sq. In.	Elong. on 2 in. per cent.
Bar cut from edge ..	23.45	13.5
Bar cut from centre ..	20.35	10.5

It may be of value here to quote from a paper, "Some Experiences with Malleable Cast Iron,"† by H. Field. Speaking of white-heart, Field says: "There are upwards limits of section which cannot be successfully malleablised. Heavy castings 4 or 5 in. thick can be repeatedly annealed, so that the true malleablising penetrates for a distance of 1 in. or so, and the whole casting is thus rendered exceedingly strong, but in the author's experience there always remains over 2 per cent. of carbon at any depth greater than 1½ in., and under these circumstances the interior metal, although soft to a drill, would, cut out into test bar form, show only very low extension and bend properties. Such castings find extensive use in engineering construction, but it should be clearly realised that for true malleable iron, to give 45 deg. bend or 5 per cent. elongation, a section of ¾ in. represents the practical maximum."

Pyrometry

It can be stated quite definitely that unless some form of temperature measurement is adopted in the annealing operation good malleable cannot be made with regularity and certainty. Although optical and radiation pyrometers can be used, they need a certain amount of skill and understanding to be of value. Apart from the personal element in the case of the optical instrument, they both give erratic results unless focussed on a clear oven, flame and smoke making any readings worthless. The only type of pyrometry that can be wholeheartedly commended is the recording thermocouple. The couple should be immersed in an annealing pot with the castings, otherwise it simply records the temperature of the oven atmosphere, and the pots lag behind this to such

Table IX.—*Analyses of the Hard and Annealed 2½ in. Diam. White-Heart Block.*

	T.C.	Gr.C.	C.C.	Si.	Mn.	S.	P.	Cr.
Hard Iron.	2.72	nil.	2.72	0.834	0.204	0.256	0.075	0.020
Annealed ¼ in. from edge ..	2.42	1.40	1.00	0.834	0.198	0.325	0.071	0.022
Annealed ¾ in. from edge ..	2.57	1.59	0.98	0.834	0.207	0.312	0.071	0.022
Centre	2.64	1.60	1.04	0.834	0.215	0.349	0.069	0.023

* A Paper presented to the Leicester Convention of the Institute of British Foundrymen.

† Foundry Trade Journal, Vol. XXXV, Page 249 *et seq.*

an extent as to make it impossible to tell when the castings are up at heat. The couples may be made of platinum-rhodium, chromel-alumel or iron-constantan. The platinum-rhodium couple has practically an indefinite life, but the initial cost is high, and furthermore the electro-motive-force generated is very small. For example, at 900 deg. C., it is 9.2 milli-volts, whereas with chromel-alumel it is 37.0 m.v., and iron-constantan 52.0 m.v. The iron-constantan couple is useless for white-heart annealing, as its working limit is below 900 deg. C., and even at temperatures of 800 to 850 deg. the life is not very good. It will not withstand oxidising conditions, and this combined with other factors make it undesirable for malleable work. The chromel-alumel has a working life up to 1,300 deg. C., and gives very good service at around 900 deg. C. A reducing atmosphere is, however, fatal to it, as also to the platinum-rhodium.

It is necessary to protect the couples with a sheath, and nickel-chrome alloys give the best service, particularly if it is further protected from the sulphurous and reducing gases by an outer sheath of iron which is cheap and readily renewable.

The recorders may be either of the galvanometer or potentiometer type. The galvanometer type is simple and gives good results, but the effect of the resistance in the leads must be taken care of, either by a high internal-resistance in the instrument, or by carefully bringing up the external resistance to a definite figure for which the instrument has been calibrated. The potentiometer recorders do not use the current generated by the couple for actuating any mechanism but simply balance it with a standard E.M.F., which is brought down by resistances. In this type the resistance of the leads has no effect on the accuracy which is an outstanding advantage. The mechanism of the potentiometer recorder is much more complicated than that of the galvanometer type, but it is possible to make all parts of the potentiometer more robust, and the authors have a preference for this type.

The pyrometric practice which has given the greatest success in the authors' experience is here described. One chromel-alumel couple is immersed in a pot at the front of the oven and one in a similar position at the back. The height chosen is one-third of the total height of the pots.

These couples are connected to indicators at the back of the ovens conveniently situated for the fireman's use. The indicators are equipped with selector switches and the fireman is required to record the temperatures on an oven sheet at frequent intervals. The couples are further connected through the indicators to remote recording potentiometers which give a continuous record of the couples and serve as a check on the fireman's operation. The chart shown in Fig. 17 was obtained by this system and it will be noted that the back and front have been maintained at almost even temperatures.

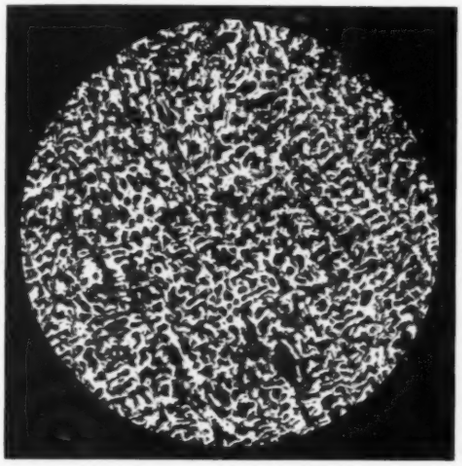


FIG. 16A.—2½-IN. DIAM. WHITE-HEART BLOCK, BEFORE ANNEALING. ETCHED × 50.

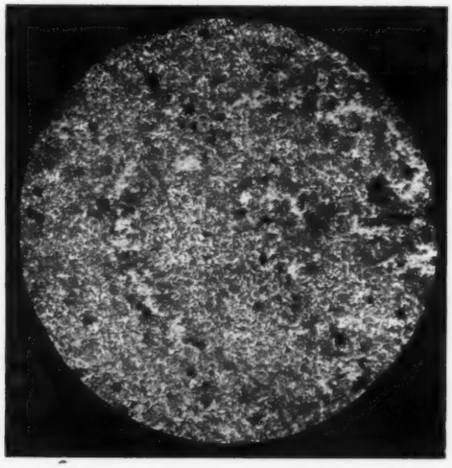


FIG. 16B.—2½-IN. DIAM. WHITE-HEART BLOCK. ANNEALED. ¼-IN. FROM EDGE. ETCHED × 50.

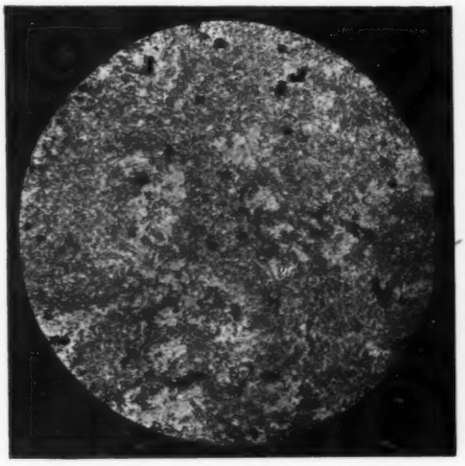


FIG. 16C.—2½-IN. DIAM. WHITE-HEART BLOCK. ANNEALED. ⅜-IN. FROM EDGE. ETCHED × 50.

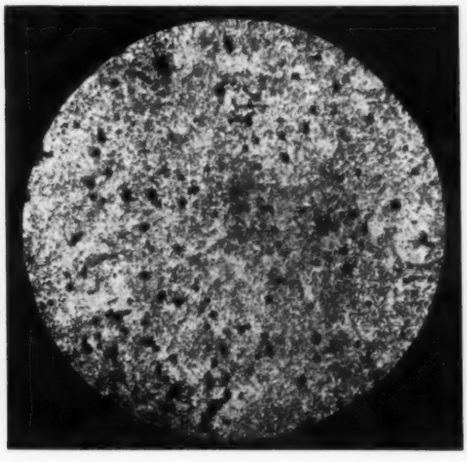


FIG. 16D.—2½-IN. DIAM. WHITE-HEART BLOCK. ANNEALED. CENTRE. ETCHED × 50.

THE EFFECT OF THE COMMON ELEMENTS ON BLACK-HEART MALLEABLE.

Carbon.

The carbon content in well-annealed black-heart chiefly determines its strength and ductility. Since the structure is a ferrite matrix with carbon nodules dispersed throughout, the strength and ductility of the metal is that of the ferrite less the weakening effect of the free carbon. For example, good malleable with 2.80 per cent. or more carbon will not yield above 18 or 19 tons tensile strength nor give more than about 8 per cent. elongation. With a 2.00 per cent. carbon, tensile strengths of 30 tons associated with over 30 per cent. elongation have been obtained. Generally speaking carbon contents below 2.20 present casting difficulties due to the higher freezing point and shorter life of the molten metal which very much outweigh the increased physical properties. The higher carbon material will anneal more readily, but the silicon must be varied inversely to obtain a graphite-free, hard-iron, which neutralises the benefit which might be obtained.

Silicon.

The silicon is governed, as just indicated, by the carbon content. Within the narrow range of carbon permissible in good quality material the silicon may run from 0.75 per cent. with the higher carbons of, say, 2.50 per cent. up to 1.00 per cent. with carbons of 2.20 per cent. Increased silicon favours graphitisation, but its usefulness in this direction is limited by the fact that there must be no graphitisation in the hard iron.

Sulphur.

Sulphur has such a strong restraining effect on graphitisation that in a material which relies upon complete graphitisation for its useful properties, the sulphur must be kept as low as possible. The practice of increasing the manganese content to neutralise the effect of the sulphur cannot be carried beyond certain limits on account of the effect of the manganese as explained later.

Manganese.

The manganese must be present in sufficient quantity to neutralise whatever quantity of sulphur is present. The amount is not, however, the theoretical requirement to form manganese sulphide, *i.e.*, 1.72 times the sulphur content, but is in excess of this. Actual practice has established that the excess required increases with the sulphur content. With 0.04 per cent. sulphur the excess required is in the neighbourhood of 0.20 per cent. If the excess is more than 0.25 per cent. the manganese retards graphitisation, a feature which has been taken advantage of to produce castings for certain purposes as explained later, under the heading of "Picture Frame" material.

Phosphorus.

This element appears to have no effect until in excess of about 0.20 per cent., above which it is not completely soluble in the ferrite and is detrimental to the physical properties of the annealed product. It may be that the higher limit of phosphorus assists to overcome running difficulties.

Chromium.

Chromium definitely retards annealing even in small amounts of the order of 0.01 per cent. Most pig-irons contain chromium in quantities up to 0.10 per cent., so that care must be taken in the choice of pig-irons.

THE EFFECT OF THE COMMON ELEMENTS ON WHITE-HEART MALLEABLE.

Carbon.

High-carbon content is prejudicial to the annealing of white-heart, as it favours graphitisation and consequently decreases the extent of decarburisation. Whilst low-carbons might be advantageous, the production of such iron in the cupola is difficult. Experience shows that carbon from 2.8 to 3.1 per cent. gives the best results.

Silicon.

With silicon-contents below 0.40 per cent. it is almost impossible to anneal the hard iron satisfactorily. Silicon around 1.0 per cent, increases the extent of graphitisation on annealing, and is opposed to the removal of carbon on account of this. As with black-heart, the content has to be varied inversely with the carbon in order to produce a graphite-free casting. With the desirable carbon contents indicated above silicon from

0.50 to 0.80 per cent. will be found suitable for most purposes.

Sulphur.

This element is no doubt the controlling factor in the production of white-heart. Its effect on graphitisation is so well known as to need no explanation. It is the one element which makes the essential difference between the two types of malleable.. If the sulphur-content is below 0.10 per cent. graphitisation will take place in preference to decarburisation and the result is a weak iron, little better than grey iron, and is in fact very similar to the result of a high-silicon content.

Sulphur above 0.45 per cent. prevents practicable annealing. Reasonable sulphur contents to produce good annealed castings are from 0.20 to 0.30 per cent.

Manganese.

From the foregoing remarks on sulphur content, it will be realised that the manganese must be low enough to allow the sulphur to exert its restraining influence on graphitisation. Yet it must not be so low as to permit the sulphur to prevent the dissociation of the carbide and so prohibit the removal of carbon by oxidation from the ore. It has been found by experience that the atomic ratio of 1.72 times the sulphur gives the best conditions.

Phosphorus.

The effect of this element is as previously given in reference to black-heart.

Chromium.

Higher chromium is permissible in white-heart than in black-heart, as its stabilising effect upon the carbide is not so detrimental and up to a certain point is beneficial. Quantities above 0.20 per cent. however appear to reduce the rate of decarburisation seriously.

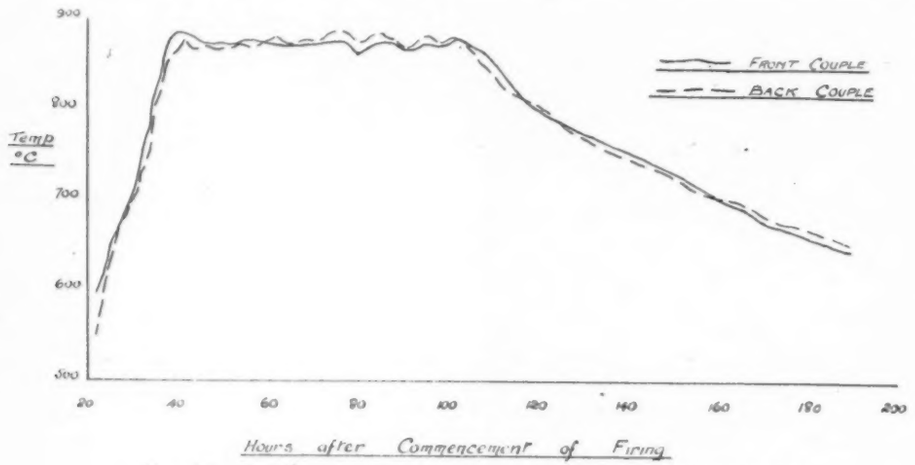


FIG. 17.—TEMPERATURE-TIME CHART OF BLACK-HEART ANNEALING CYCLE.

TABLE X.—*Physical Properties of Black-Heart Malleable Tensile Bars* 0.564 (9-16 *in.*) *Dia. Bend Bars* 1 *in.* × ⅜ *in.*

Description.	M. S. Tons per sq. in.	E. per cent. on 2 in.	Bend. Degs.
Average of 100 Consecutive Heats	24.80	19.9	175
Bar with Highest Tensile Strength	27.00	19.0	180
Bar with Lowest Tensile Strength	22.20	19.0	180
Bar with Highest Elongation	24.88	27.0	180
Bar with Lowest Elongation	24.36	13.0	160

Physical Properties of Black-heart.

The tensile strength of black-heart is 23 to 27 tons per sq. in., associated with an elongation of 15 to 25 per cent. on 2 in. The yield point is 15 to 18 tons per sq. in. and about 20 per cent. reduction in area. These figures are for results on a 0.564-in. dia. bar. The bend test on a 1 in. × ⅜-in. bar round a 1-in. radius gives about 180 degrees. Some interesting figures are given in Table X. Unlike other metals, the elongation of black-heart malleable increases with the tensile strength. This is shown in Fig. 18. The material is very soft and gives a Brinell number around 110 and a value on the Shore scleroscope of about 15. It possesses useful magnetic properties and is used to a considerable extent in electrical industries. It has high permeability and very low hysteresis loss and coercive force. Figures are given in Table XI. Greater resistance to rusting is shown by malleable than by other ferrous materials of similar shock and strain-resisting qualities. This is probably due to the surface of a malleable casting being practically carbon free.

TABLE XI.—*Magnetic Properties of Black-Heart Malleable.*

Description.	Test A.	Test B.
Maximum Magnetising Force. C.G.S. units	109	107
Maximum Magnetic Induction. Lines per sq. cm.	10,875	11,375
Residual Magnetism. Lines per sq. cm.	5,125	4,500
Maximum Permeability ..	1,500	1,750
Coercive Force. C.G.S. units.	2.5	2.0

Machinability of Black-heart.

The free-cutting properties and speeds of machining attained on black-heart malleable are exemplified by the following figures. These were obtained from a well-known firm of machinists who completely finish some 20 to 30 tons of motor car details per week.

Turning and facing flange 10 *in. dia. on a large casting.*

Roughing speed	...	108 ft. per min.
Finishing speed	...	182 ft. per min.

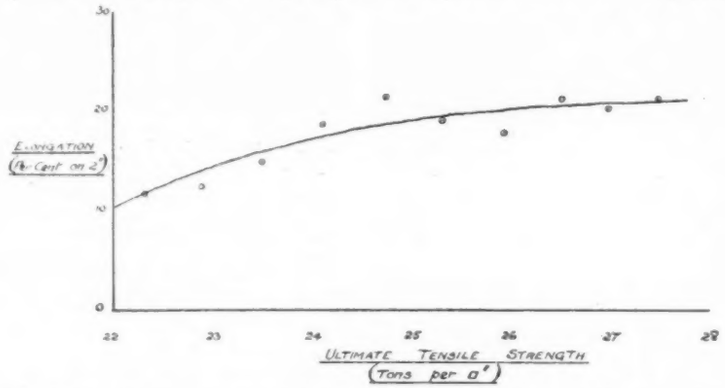


FIG. 18.—SHOWING PROGRESSIVE INCREASE OF DUCTILITY, WITH TENACITY OF BLACK-HEART MALLEABLE.

Turning and facing cylindrical piece 6½ *in. dia.*

Roughing speed	...	140 ft. per min.
Finishing speed	...	400 ft. per min.

Turning and screw-cutting a light sleeve casting

Rough turning...	...	100 ft. per min.
Finish turning...	...	235 ft. per min.
Screw cutting with single point tool	...	170 ft. per min.

This job is one of great accuracy, the working limit allowed being plus or minus 0.0005 in. Precision in the diameter of the thread is secured by working to a dial indicator, and hundreds of the piece are so produced without regrinding the tool.

As regards uniform machinability and absence of hard spots the record of machining 39,207 radiator ferrules 1¼ in. dia. screwed right- and left-hand threads, without regrinding the dies is sufficient evidence.

Picture Frame Material.

It will be seen from the foregoing remarks on machinability that this material will not be suitable for all classes of castings, especially those which have to withstand abrasion and wear. Such requirements can be met by the production of castings with what is commonly called "picture frame" fracture. Fig. 19 shows this feature. It will be seen from this photograph and from the micrographs Figs. 20 and 21, that the core of the material is of usual black-heart quality and structure, but is surrounded by a border or rim which is mainly pearlitic. This material has a slightly higher tensile strength than the normal iron, averaging approximately 26 tons per sq. in., with a lower elongation which runs from 10 to 15 per cent. Bend tests of 90 deg. round a 1 in. radius are obtained. The hardness values taken on the surface are much higher than usual, being 30 to 35 scleroscope (equivalent to about 250 Brinell). This special class of malleable is obtained by slight alterations of the composition of the hard castings. The carbon is higher, at about 2.60 per cent. together with lower silicon and higher manganese contents. The sulphur is unaltered. The "picture frame" fracture can be achieved also by lowering the manganese content, the other elements remaining as before mentioned. The annealing treatment is exactly the same as in usual practice.

Reference should be made to the remarks on the theory of annealing black-heart malleable, where it was stated that when graphitisation was carried on until equilibrium was attained, there was always a certain amount of carbon which was not graphitised, this amount being definite for any temperature. At just above Ar_1 this amount is about 0.45 per cent., and it can only be graphitised by holding at or just below Ar_1 for a sufficient time. The time required is greatly affected by small changes in the composition, *e.g.*, increased manganese lengthens the time requisite to such an extent that the ordinary rates of cooling are not slow enough to permit the final graphitisation, and some of this 0.45 per cent. of carbon is found as pearlite in the annealed material.

It would naturally be thought that this pearlite would be distributed throughout, but such is not the case, and it is always found in the rim as shown in micrograph Fig. 20. Many explanations

of this phenomenon have been attempted, but none has met with general acceptance.

The 0.45 per cent. of carbon previously mentioned as existing ungraphitised at Ar_1 is distributed evenly throughout, and, even with this special composition, is graphitised in the core, but in the rim it is considered that decarburisation has

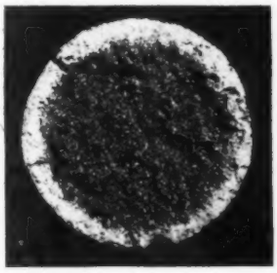


FIG. 19.—FRACTURE OF "PICTURE FRAME" MATERIAL.

always proceeded so far that graphitisation here is restrained. Further, the authors believe that the particular composition adopted produces more surface decarburisation than is normal, owing to the slightly decreased speed of graphitisation, which would be expected with the lower silicon and unbalanced sulphur and manganese.

Physical Properties of White-heart.

Good white-heart malleable has a tensile strength of 23 to 30 tons per sq. in. and an elongation of 5 to 10 per cent. on 2 in. The yield point is about 16 tons per sq. in., and the reduction in area is about 10 per cent. The bend test on a ⅜-in. bar round a 1-in. radius is from 45 to 90 deg. Some figures are given in Table XII.

TABLE XII.—*Physical Properties of White Heart Malleable. Tensile Bars* 0.375 *in.* (⅜ *in.*) *Diam. Bend Bars* 1 *in.* × ⅜ *in.*

Description.	M. S. tons per sq. in.	E. per cent. on 2 in.	Bend. Degs.
Average of 162 Consecutive Tests	24.60	8.3	57
Bar with Highest Tensile Strength	31.00	4.0	30
Bar with Lowest Tensile Strength	22.80	8.0	95
Bar with Highest Elongation	25.60	15.3	60
Bar with Lowest Elongation	31.00	4.0	30

These figures are for a tensile test bar of ⅜-in. dia. White-heart machines readily and a figure of 90 ft. per min. is representative of well-annealed material. The metal cannot be machined so readily throughout, as the combined carbon content is too high when more than about ⅛ in. has been removed. It is, however, easily drilled through any normal section. No figures have been obtained respecting any useful electrical properties, but it may be expected to possess fairly high permeability. Its rust-resisting properties are like those of black-heart, the surface of the two materials being similar in structure.

General Considerations of Costs.

From a perusal of this Paper, it will be evident that the cost of producing malleable is very much higher than ordinary grey-iron castings of similar shape and size. The chief items of increased cost may be briefly summarised as follows:—

(1) Higher cost of pig-iron, owing to necessity of ensuring the accurate analysis of charge, and the special qualities of hematite required.

(2) For black-heart, high operation cost of melting in air furnace, caused by amount of fuel required and heavy expense of maintaining brickwork. For white-heart additional cost of extra fuel for cupola.

(3) Higher melting-losses.

(4) Additional weight of molten metal required to run the castings owing to the necessity of feeders, etc.

(5) Annealing expense covering plant, maintenance of brickwork, and fuel.

(6) Extra cost of cleaning castings run at higher temperature, necessitating sand-blasting in many cases—also further cleaning and barrelling after annealing.

(7) Higher grinding and fettling costs owing to excess metal arising from feeder heads and chipping away of ties not removable before annealing; and

(8) Accurate setting under press or drop hammer to enable the castings to be located in intricate jigs for mass machining.

When reviewing the foregoing items, it is of

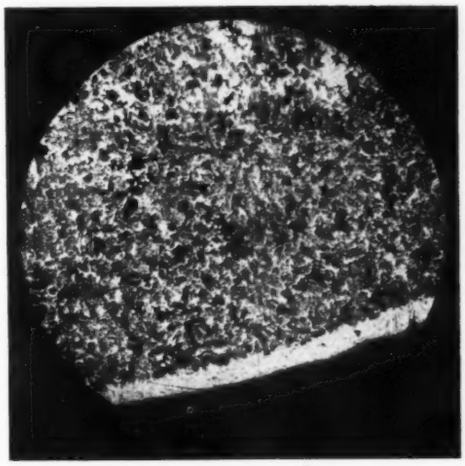


FIG. 20.—RIM OF "PICTURE FRAME" METAL. ANNEALED. ETCHED × 50.

interest to note that regarding item 4, there is a very great variation in the weight of feeders for different castings, which is caused by the variety of designs. This results in a difference of between 30 and 70 per cent. on good castings per ton of metal melted. It is evident from this that there must be a wide variation in the cost of production, and that any flat rate covering a range of castings could not be satisfactory, either to the founder or the buyer, and is therefore economically unsound.

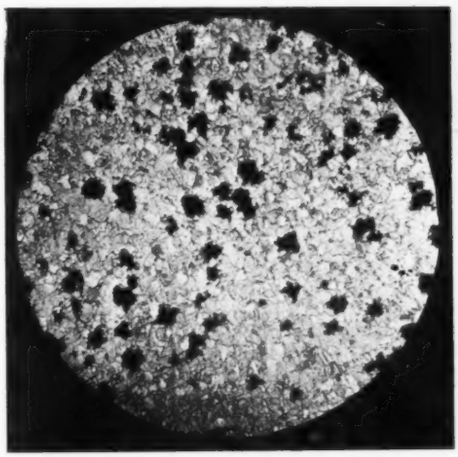


FIG. 21.—CENTRE OF "PICTURE FRAME" METAL. ANNEALED. ETCHED × 50.

With regard to the question of annealing expense, this vital portion of the process is an expensive operation to carry out satisfactorily, and the annealing cycle cannot be shortened if regular and reliable results are to be obtained. Some firms talk about annealing periods which are very much shorter than those given in this Paper, but the authors up to date have not been able to achieve any of these wonderful results.

It often happens that the malleable ironfounder obtains work from the engineer because a grey-iron casting has failed in service, and the engineer expects to replace it by malleable iron at approximately the same price. Needless to say, this is impossible, although with the reduction which can be brought about in weight by using malleable iron, his ultimate cost is not very much greater, although it may appear so when viewing the prices on the cwt. basis. First-class malleable castings in either black-heart or white-heart cannot be produced except by using the best methods of production, and neither material is equally suitable for all classes of work.

Extreme sections, both very heavy and very light, are to be avoided in both materials as much as possible. Some designers often try to reduce the cost by lightening their sections to such an extent that this, in some cases, so increases the cost of moulding and annealing that the ultimate cost is greater than if a more reasonable section had been adopted. To achieve success, all founders aim at having customers who are satisfied in every way, but this can only be attained if the customer allows his designer fully to co-operate with him, so that a casting may be produced on a commercial basis which is the result of mutual experience of all concerned.

In conclusion, the authors wish to thank all those who have assisted in the preparation of this Paper, and in particular they acknowledge the permission given by the Directors of Ley's Malleable Castings Company Limited, to publish much of the information contained.

Mr. Leon Thomas Honoured.

Mr. Léon Thomas, the president of the French Association Technique de Fonderie, has been decorated by H.M. the King of Belgium with a Chevalier's Cross of the Order of Leopold of Belgium. Mr. Thomas was until recently associated with the Citroën concern.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Local Authorities and the Smoke Problem.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In view of the recent recommendation of the National Smoke Abatement Conference that local authorities should investigate the supply and suitability of various smokeless fuels as a means of mitigating the domestic smoke evil, the experience of the West Riding of Yorkshire Regional Smoke Abatement Committee may be of help to both administrative bodies and the public.

Ever since this Committee was constituted three years ago, it has endeavoured to discover some method of reducing domestic smoke, which is generally acknowledged to provide the greater part of the suspended solid matter in the air. We have naturally been extremely cautious in regard to any general recommendation, but after a most careful investigation we are convinced that low-temperature carbonisation has now reached a state of development where solid smokeless fuel is produced commercially at a price which, having regard to bulk and thermal efficiency, can be recommended to the public as an adequate and economical substitute for coal.

In arriving at this decision, the Committee has been particularly influenced by the result of its investigations into the commercial production of smokeless fuel in Yorkshire. Practical tests of the burning of such fuel, conducted under various conditions—in a well grate, an old-fashioned bar grate, an old type of Yorkshire range, a modern kitchen range, and a sectional boiler—all gave highly satisfactory results.

Trusting that this experience will be of benefit to any local authority or Smoke Abatement Committee which is endeavouring to give effect to the recommendations of the conference,

I am, Sir, etc.,

(Signed) J. JOHNSTONE JERVIS.

(Hon. Sec., West Riding of Yorkshire Regional Smoke Abatement Committee.)

Public Health Department, Leeds.

[We can endorse the above from practical experience.—EDITOR.]

Trade Talk.

THE FOUNDRY & ENGINEERING COMPANY have removed from Albion into new works at Sandwell Road, West Bromwich.

EXPORTERS OF PIG-IRON and ferro-alloys to France should note that there have been considerable modifications in the customs tariff for these commodities.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have secured a contract for ten locomotives from the Leopoldina Railway, of Brazil.

THE NEWRY URBAN COUNCIL have accepted the tender of Messrs. John Butler & Company, Limited, Leeds, at £9,947, to construct a bridge over the canal at Newry.

THE LONDON OFFICE of Messrs. Hopkinsons, Limited, Britannia Works, Huddersfield, has been removed from Imperial House, Kingsway, to 34, Norfolk Street, Strand, W.C.2.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have purchased the shipyard of Messrs. Dobson & Company, which adjoins their Walker yard, Newcastle-on-Tyne.

THIRTY-NINE SHIPS, of a total tonnage of 149,259, were launched on the Tyne in the past five months. This is an increase of 20 vessels and 82,655 tons over the corresponding period of last year.

A MEETING IN SUPPORT of peace in industry under the joint auspices of the Industrial Peace Union of the British Empire and the Empire Trade League will be held at the Mansion House on July 9.

MESSRS. HARLAND & WOLFF, LIMITED, Belfast, are now laying the keel of a new liner for the White Star Line. It is understood that she will be the largest vessel in the world, with a length of 1,000 ft., a beam of 100 ft., and a gross tonnage of 60,000.

MESSRS. REAVELL & COMPANY, LIMITED, of Ipswich, have added to their directorate Mr. R. L. Quertier and Mr. Kingsley Reavell. Mr. Quertier has been manager of the London offices of the company for many years, and Mr. Kingsley Reavell is the son of the managing director, Mr. William Reavell.

SINCE THEIR RECENT ORDER from the Russian Soviet Government for textile machinery to the value of about £500,000, Messrs. Platt Brothers & Company, Limited, of Oldham, have received a substantial extension of the order, which will enable them to run full time for the greater part of the present year.

THE WHITEHAVEN HEMATITE IRON AND STEEL COMPANY, LIMITED, have discovered an excellent body of ore in the Lamplugh district. It appears that they bored three holes and decided to experiment with two further holes, with the result that they have found the products of the latter two borings were much superior to the former three.

THE BRITISH CONSUL-GENERAL at Lourenço Marques has forwarded particulars of a scheme for the introduction of irrigation in the Province of Mozambique, indicating a possible demand for boilers, engines, pumps, cast-iron and lapwelded-steel piping, semi-portable engines and boilers combined—locomotive type, etc. Further information can be obtained on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

THE EFFECT of the Government's rating scheme on the steel industry was discussed by Mr. H. G. Williams, M.P., Parliamentary Secretary to the Board of Trade, in the course of a statement last week. On the average, he said, the rating relief on the steelworks, coupled with the reduced rates of railway freight on the raw materials for steel, would average about 4s. per ton. Since competition was keener in some directions than in others, steel manufacturers probably would not use the relief accorded to them for the purpose of distributing it uniformly over the whole of their products, but would utilise it to cut prices much more than the average 4s. a ton in the cases of those lines where competition was very acute. There might be cases where manufacturers would see their way to make cuts of as much as 10s., or even more, per ton.

THE GRINDING AND PULVERISING OFFICES of International Combustion, Limited, 11, Southampton Row, London, W.C.1, report that orders have recently been received for the following equipment:—For England: Three 8 ft. by 48 in. Hardinge ball mills, in conjunction with three 6-ft. Hardinge superfine classifiers, for grinding phosphate; one 8 ft. by 36 in. Hardinge ball mill, for grinding tin sands; one 8 ft. by 36 in. Hardinge pebble mill, in conjunction with one 4 ft. 6-in. Hardinge classifier, for grinding feldspar; one 4 ft. single-body type tandem Hummer screen, for screening coal; and one Ro-tap testing sieve shaker. For France: Six 8 ft. by 60 in. Hardinge ball mills, for grinding coal; one 6 ft. by 22 in. Hardinge ball mill, for grinding lead ore; two five-roller Raymond mills, for grinding coal; and one three-roller Raymond mill, for grinding charcoal.

Contracts Open.

Birkenhead, July 2.—Iron and steel stores, for the Corporation. The Gas Engineer, Gasworks, Thomas Street, Birkenhead.

Cork, July 5.—90 tons of 6-in., 15 tons of 4-in. and 15 tons of 3-in. cast-iron s. and f. water pipes, with special castings, for the Corporation. The Waterworks Office, Fitzgerald Park, Cork. Mr. T. Ireton, town clerk.

Johannesburg, July 26.—Nickel chrome steel, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 6400.)

Southborough, July 3.—Supply and laying of about 370 yds. of 4-in. cast-iron water main, with connections to existing main, new valves, hydrants, etc., for the Urban District Council. Mr. W. N. Wood, clerk, Council Offices, Southborough.

Buenos Aires, July 10.—Pumping plant, for the Argentine National Sanitation Works Department. The Department of Overseas Trade. (Reference A.X. 6389.)

Johannesburg, August 9.—Six electrically-driven overhead travelling cranes, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 6409.)

Swindon, July 7.—Supply, delivery and erection of steam exhaust water and other pipework, valves, tanks, evaporators, etc., for the Corporation Electricity Department. Messrs. Preece, Cardew & Rider, 8, Queen Anne's Gate, Westminster, S.W.1. (Fee £2 2s.; returnable.)

Obituary.

CAPTAIN O. H. D. VICKERS, a special director of Messrs. Vickers, Limited, died suddenly at Weybridge.

MR. JOHN KENT, who for many years was manager for Messrs. W. Rainforth & Sons, Limited, Britannia Ironworks, Lincoln, died recently.

MR. JOHN BERRY, proprietor of the New Bank Foundry, Halifax, has died at the age of 79 years. The business was established by Mr. Berry's uncle over a century ago, and he himself had been identified with it for 65 years.

MR BENJAMIN W. BOYES, managing director of Messrs. Samuel Tyzack & Company, Limited, Sunderland, died at Stockton last week. Before accepting the Sunderland appointment Mr. Boyes was for many years with the South Durham Steel and Iron Company at West Hartlepool in managerial positions. Until his health began to fail he was chairman of the North-East Coast Barmakers' Association and vice-chairman of the North-East Coast Rivetmakers' Association. He was about 60 years of age.

Personal Paragraphs.

MR. GEORGE R. T. TAYLOR, deputy chairman of Messrs. Vickers, Limited, has been appointed deputy chairman of Messrs. Vickers-Armstrongs, Limited.

MAJOR JOHN COLVILLE, a director of Messrs. David Colville & Sons, Limited, Glasgow, has been chosen as prospective Unionist candidate for North Midlothian.

SIR ALFRED MOND, BT., one of the new peers in the King's Birthday Honours List, has taken the title of Baron Melchett of Landford. Sir Alfred is chairman of Imperial Chemical Industries, Limited, and many other companies.

Wills.

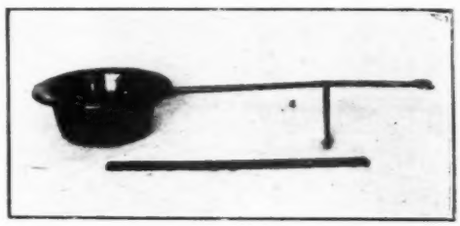
MATTHEY, P. ST. CLAIR, metallurgical chemist	£169,488
MCGREGOR, A., of the Ardeer Foundry Company, Stevenston, Ayrshire	£120,852
OWEN, J., founder of John Owen, Limited, iron merchants, Neath	£3,884
COOK, SIR HENRY, of Edinburgh, a director of the General Iron Foundry Company, Limited	£91,655
BROWN, T., of Leigh-on-Sea, formerly representative of Messrs. McDowall, Steven. & Company, Limited, iron-founders, Falkirk	£6,585

MESSRS. FLEMING & FERGUSON, LIMITED, Paisley, have received an order for five dredgers for the Federated Malay States.

A Posset Pan.

Were we to go into an ironmonger's shop to-day and ask for a posset pan, the man at the counter would be surprised. Yet posset pans were formerly quite common for some hundreds of years. Our illustration shows a particularly good example in perfect condition, though made something like a hundred years ago.

This pan, it will be noticed, has a particularly long and slender handle, with a foot attached to permit the whole to stand firmly. It is made in two pieces—an iron frame and handle with a brass bowl set in the frame, the bowl being of a beautiful red colour, which we may take to be an alloy with a larger proportion of copper than is usual. The whole differs in a very slight degree from the ancient skillet, or mediæval saucepan, a cousin of which indeed it is, though a lighter and smaller utensil. The foot-rule indicates the proportions of the vessel. Skillets and posset pans are very rarely to be met with to-day. The posset was a hot, sweet drink, composed of various ingredients, but mainly of ale or wine and milk, with probably other variations, according to taste. It was spposed to be a sovereign remedy for a chill, and was taken at bedtime. For our illustration we are indebted to the Curator and Committee of the Winchester Museum, in whose care the pan now rests.



Welding of Stainless Steel.

In the welding of alloys of all descriptions many problems have had to be solved. It is not so very long ago, a mere matter of fifteen years or so, that welders were compelled to admit that the welding of alloy metals was beyond them. The coming of the electric arc has altered the position materially, but while simplifying much of the work, it has created problems of its own, since the intense heat has a way of creating fresh compounds with, from the welders point of view, inconvenient results.

Nearly seven years ago Alloy Welding Processes, Limited (who have made a special study of this subject), succeeded in satisfactorily welding stainless steel, and since then have been supplying stainless-steel electrodes (comprising about 18 different types), with satisfactory results.

From the very first, the materials to form the particular alloy required were mainly incorporated in the flux coating, but the necessary nickel was added to the core wire by electro-deposition. The original stainless steel, composed of varying percentages of chromium and iron, while satisfactory for many purposes was found to be unsatisfactory when used for the manufacture of chemical vessels, with the result that many other alloys have been put upon the market, each of which shows certain advantages, but all again presenting problems in the welding of them.

It is satisfactory to know that in the manufacture of stainless steels, as well as in their welding, this country is far in advance of any other. It is only during the past eighteen months or two years that the welding of such steels has been accomplished in the United States, and then only by the use of materials imported from this country. At the present time the exports of welding materials to the United States have reached quite a satisfactory level.

Midland Institute of Mining Engineers.—The 70th annual general meeting of this Institute will be held at the Buxton Hydro Hotel, Buxton, on Saturday, July 14, 1928, at 3 p.m. Arrangements have been made for members to visit the Safety in Mines Research Station at Harpur Hill, Buxton, at 11 a.m., where a demonstration coal-dust explosion will be given. In the afternoon Mr. George S. Rice (Chief Mining Engineer of the U.S.A. Bureau of Mines) will deliver a Paper entitled "Mine Rescue Work in the United States of America."

XUM

TELEGRAMS: "IRON BILSTON."

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Bilston.

COLD BLAST IRONS

for Chilled Castings.

Chills and analysis guaranteed.

CHARCOAL

REFINED HEMATITES

for Malleable Castings.

TEAM BY-PRODUCT COKE CO., LTD.

DUNSTON-on-TYNE

"TEAM" PATENT COKE

SPECIAL FOUNDRY QUALITY

FOR PRICE AND PARTICULARS APPLY TO:—

ALEXANDER LEITH & CO.,
25, COLLINGWOOD STREET,
NEWCASTLE-ON-TYNE.

TYPICAL ANALYSIS (if necessary guaranteed)

ASH	not exceeding	8%
SULPHUR	,, ,,	0·8%
VOLATILE	,, ,,	1 %
MOISTURE	under	1·50%

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,

FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & CO., LTD.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Although by no means an exceptional condition at this period of the year, the slackness now observable in the Cleveland iron trade has reached a stage of all-round depression seldom recorded in recent years in the history of the industry. These conditions, unfortunately, apply equally as regards home consumption and export demands, the foundry industry especially being but poorly off for work, and consequently confining orders within the narrowest possible limits, while shipments for the month so far show a very slight advance of a few hundred tons as compared with the returns for the corresponding period in May. In Scotland, though imports of foreign pig-iron have virtually ceased, Midland makers are slightly under-selling Cleveland, and, in any case, consumption is on the down-grade. It is not now expected that there can be any substantial improvement in the demand until the autumn. Nevertheless, in spite of all these adverse factors, Cleveland iron maintains its price, makers presenting a united front in fixing the following as the minimum selling prices:—No. 1 Cleveland foundry iron, 68s. 6d. per ton; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d. per ton. These prices are uniform both for home consumption and for export.

Slightly more satisfactory conditions are reported in regard to the East Coast hematite market, but considerable improvement is still essential before a full recovery of trade can be expected. Meanwhile, prices are a shade firmer at 68s. 6d. to 69s. for mixed numbers, while on the North-West Coast Bessemer quality is still quoted at 70s. per ton at works.

LANCASHIRE.—Interest in the local markets for foundry pig is now chiefly centred on the keen competition between Midland furnaces for current business, which is now developing into a price-cutting struggle for any orders that may be offering at the moment. In these competitive conditions quotations for Derbyshire No. 3 foundry during the past week, for delivery Manchester or equal distance, have ranged from 69s. up to 71s. 6d. per ton, with Staffordshire brands from about 69s. to 70s. Quotations for other foundry irons offering on this market keep relatively steady, however, North-East Coast makes being quoted at round 79s., and Scottish at about 87s. 6d.

THE MIDLANDS.—In the South Staffordshire area ironfounders find business extremely quiet, and what orders they can secure are at very cut figures. Only in isolated cases does one hear of forward bookings, and these are at very low rates. Meanwhile, there have been no further alterations in prices, Northants. being offered at 55s. and 56s., Derbyshire, 60s. to 61s., and North Staffordshire, 60s. to 61s. f.o.t. Lincolnshire and Cleveland irons are quoted 72s. 6d. and 81s. 9d. respectively, and Scotch No. 3 iron is on offer at about 89s. per ton.

SCOTLAND.—No improvement can be reported in the position of the Scotch pig-iron market. Business continues on very meagre lines, and the tendency is to shrink still further in view of the approaching annual holidays next month. Prices are unchanged on the basis of 70s. for No. 3 foundry f.o.t. furnaces.

Finished Iron.

In the Black Country area, apart from the makers of marked bars, the ironworks are still very badly situated for work. There is not nearly sufficient business available for crown and nut and bolt irons to keep the mills even moderately occupied, and there is extensive competition for the limited tonnage of business possible. Quotations for crown iron continue to vary to a considerable degree, and are anything from £9 to £9 15s. per ton, with nut and bolt quality about £8 15s. per ton, delivered this area. The makers of marked bars adhere to their figure of £12 at makers' works, and are fairly well engaged. There has been a slight fall in the price of Belgian No. 3 iron for the nut and bolt trade in the Midlands, and this material is now being offered quite freely at £6 12s. 6d. per ton delivered works.

Steel.

At Sheffield during the current week there has been a fair inquiry for open-hearth acid billets, but the market for basic billets has become quieter again, although prices have undergone no change, and are as follow:—Soft, £6 5s.; semi-hard, £7; medium hard, £7 2s. 6d.; hard, £7 12s. 6d. There is only a poor demand for wire rods, the prices of which are:—Acid, £12 10s.; soft basic, £7 10s.; medium hard, £9 10s. to £10; hard, £11 10s. to £11 15s. The production of open-hearth steel in this district is falling away rather badly, and is now something like a third of full capacity. Crucible and electric steel output is on a moderate scale, but the demand for stainless steel continues to expand. In the tinplate market the home trade is fairly good, consumers covering their requirements over the next three or four months. Current quotations are as follow:—Coke tinplates, 18s. 6d. to 18s. 9d. basis for usual specifications, net cash, f.o.b. Welsh ports.

Scrap.

Conditions in the scrap metal markets continue irregular, with considerable variations in volume of demand and prices according to particular localities. In the Tees-side area the values of ordinary and machinery cast-iron scrap are still maintained at 62s. and 66s. per ton respectively, while similar qualities of material in the Midlands are quoted at 65s. to 67s. 6d. delivered. In Scotland first-class machinery cast-iron scrap is nominally 67s. 6d. per ton, and for ordinary heavy cast-iron scrap to the same specification 62s. 6d. per ton is quoted. Old cast-iron railway chairs show a little better inquiry at 65s. to 67s. 6d. per ton, and light cast-iron scrap at 56s. 3d. to 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Due probably to seasonal influences, the market for warrant copper during the past week has developed a weaker tendency in values, and at the close standard was 17s. 6d. to 20s. below quotations current the previous week, while electrolytic, which has also exhibited some weakness recently, declined a further 5s. The forward outlook is, necessarily, somewhat uncertain, but the general impression is that the present decline in values can be only temporary in character.

Closing quotations are:—

Cash.—Thursday, £63 3s. 9d. to £63 5s.; Friday, £63 1s. 3d. to £63 3s. 9d.; Monday, £63 2s. 6d. to £63 3s. 9d.; Tuesday, £62 18s. 9d. to £63; Wednesday, £63 2s. 6d. to £63 3s. 9d.

Three Months.—Thursday, £63 3s. 9d. to £63 5s.; Friday, £63 1s. 3d. to £63 3s. 9d.; Monday, £63 2s. 6d. to £63 3s. 9d.; Tuesday, £63 to £63 1s. 3d.; Wednesday, £63 2s. 6d. to £63 3s. 9d.

Tin.—A quite exceptional event in this section was the opening of a market for tin last Saturday, succeeding a sharp fall in the price of the metal, which on Wednesday had touched the low level of £210 12s. 6d. cash. It would appear, on this occasion, that operators were influenced by an Eastern cable advice announcing that a number of tin mines, mostly Chinese, are being closed down because of the unprofitable price level. The price of the metal came through from Singapore £1 10s. higher, while the London price was advanced by over £2 per ton. Forward tin was selling at £207 per ton, and advices from America referred to an increased demand from consumers.

Official closing prices:—

Cash.—Thursday, £211 7s. 6d. to £211 10s.; Friday, £207 15s. to £208; Monday, £211 to £211 2s. 6d.; Tuesday, £207 5s. to £207 10s.; Wednesday, £210 10s. to £210 15s.

Three Months.—Thursday, £208 12s. 6d. to £208 15s.; Friday, £204 15s. to £205; Monday, £206 7s. 6d. to £208 10s.; Tuesday, £204 17s. 6d. to £205 2s. 6d.; Wednesday, £207 15s. to £208.

Spelter.—In the market for ordinary spelter buyers apparently lack confidence in the future stability of the position, and are restricting their purchases to the covering of their immediate requirements. Quotations showed a slightly easier tendency towards the end of the week, but, on the whole, have been very well maintained in the face of the prevailing slackness. The position may possibly be influenced by the May production figures just published, which show a decrease of over 1,200 metric tons, and are the lowest recorded since September last.

Daily quotations are:—

Ordinary.—Thursday, £25 11s. 3d.; Friday, £25 12s. 6d.; Monday, £25 11s. 3d.; Tuesday, £25 3s. 9d.; Wednesday, £25 8s. 9d.

Lead.—Values of soft foreign pig are again somewhat unstable, and as buying activity has slackened off, any hardening of quotations seems improbable for the moment. Supply is proving more than adequate to meet the demand, and values would probably have fallen still further but for a partial revival of speculative interest.

Closing prices:—

Soft Foreign Prompt.—Thursday, £20 11s. 3d.; Friday, £20 10s.; Monday, £20 12s. 6d.; Tuesday, £20 10s.; Wednesday, £20 13s. 9d.

The Causes of Failure of Wrought-Iron Chains.*

Summary.

The object of the investigation was to determine the cause of the brittle failure of wrought-iron chain. Some experiments on lengths of new chain employing static tensile overstraining with intermediate and final heat-treatment showed that repeated heavy overstraining and low-temperature annealing caused notched bar brittleness in test specimens cut from the sides of links. This notched bar brittleness was not, however, reflected in the behaviour of the chain when tested as a unit under shock conditions, and its real significance is, at present, obscure. In all other respects, low-temperature annealing and normalising were found to be very valuable in removing strain-hardening effects. In another series of experiments the effects of overstraining by heavy shocks was investigated. The chief result was found to be a progressive deterioration of the welded joints. Experiments were then made on chains taken from service of known history. It was found that chains which had been periodically proved and annealed showed no signs of brittleness when tested in the annealed condition. Chains which had not been annealed were very brittle; annealing or normalising removed this brittleness. This brittleness was shown to be due to a "skin" effect, caused by surface hardening resulting from small impacts. The deleterious effect of this action is undoubtedly the major cause of the production of brittleness in wrought-iron chains. The evidence obtained in the course of the work indicates that, as the result of interlink action, hammering on ground, rattling through hawse pipes, battering on chain wheels, cleaning by rumbling machines (in certain cases), the material of the surface of the link—in some cases only to a very small depth—becomes locally hardened to such an extent that its ductility is practically exhausted. The link surface then consists of a thin, highly-brittle case covering a core possessing the ductile properties of best chain iron. When the link section is subjected to bending strains—particularly those caused by shock conditions—the hardened skin strains elastically and then cracks. This crack is of such a type that very great stress concentration occurs at its root. When the crack reaches the underlying ductile metal, the latter cannot exert its property of ductility because of the prevailing conditions of local constraint, and the crack continues its course throughout the entire section of the link, producing a fracture which has an entirely brittle (apparently coarsely crystalline) appearance throughout.

This type of fracture has been encountered during tests on chains drawn from service, and has also been produced on new chain iron bar and new chain links which have been lightly hammered in the laboratory.

Heat-treatment—low-temperature annealing or normalising—has been shown, by causing re-crystallisation in the hardened surface layers, to restore the original ductility.

Other causes—more easily identified—of failure of wrought-iron chains in service arise from defects in the material, such as, "burnt iron" and "laminated" rod. (The harmless effects of excessive sulphur, phosphorus, or carbon in wrought iron, are well known and have not been further investigated.)

The progressive deterioration of the welded scarves, due to service shocks and snatches, has also been clearly established.

* A Report published by the Department of Scientific and Industrial Research, and sold by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 7/6, plus postage.

Sterling

SOLID RIBBED ROLLED STEEL

MOULDING BOXES

are recognised as Standard Box equipment by the majority of the leading foundries and engineering establishments in this country and overseas.

Because they speed up production, save unnecessary labour, produce accurate castings and make for all-round efficiency.

If you are not a user of Sterling Boxes your competitors have the advantage of you.

STERLING FOUNDRY SPECIALTIES LTD.

London Office:
13, VICTORIA STREET, S.W.1.

BEDFORD.

Telephone : 3345 BEDFORD.
Telegrams : "STERFLASK, BEDFORD."
Code : WESTERN UNION.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	63	2	6
Three months ..	63	2	6
Electrolytic	68	10	0
Tough	65	15	0
Best selected ..	66	0	0
Sheets	94	0	0
India	77	0	0
Wire bars	69	0	0
Do. July ..	69	0	0
Do. August ..	69	0	0
Ingot bars	69	0	0
H.C. Wire rods ..	73	5	0
Off. av. cash, May ..	62	11	9 5/11
Do. 3 mths., May ..	62	15	8 3/11
Do., Sttlmnt., May	62	11	8 5/11
Do., Electro, May ..	67	9	3 5/11
Do., B.S., May ..	65	18	0 1/11
Aver. spot price, copper, May	62	11	9 1/2
Do., Wire bars, May	67	14	3 1/2
Solid drawn tubes			13 1/2d.
Brazed tubes			13 1/2d.
Wire			10d.

BRASS.

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld. ..	7 1/2d.
Sheets to 10 w.g. ..	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 × 4 Squares ..	8d.
Do. 4 × 3 Sheets ..	8 1/2d.

TIN.

	£	s.	d.
Standard cash ..	210	10	0
Three months ..	207	15	0
English	208	15	0
Bars	207	15	0
Straits	207	17	6
Australian	209	5	0
Eastern	209	10	0
Banca	Nominal		
Off. av. cash, May ..	230	19	3 3/32
Do., 3 mths., May	230	7	10 1/32
Do., Sttlmt., May	230	18	7 7/11
Aver. spot, May ..	230	19	3

SPELTER.

Ordinary	25	8	9
Remelted	24	5	0
Hard	20	0	0
Electro 99.9	29	10	0
English	25	10	0
India	21	5	0
Zinc dust	33	0	0
Zinc ashes	8	0	0
Off. aver., May ..	25	18	6 21/32
Aver., spot, May ..	26	2	0 1/2

LEAD.

Soft foreign ppt. ..	20	13	9
English	22	0	0
Off. average, May ..	20	12	11 3/11
Average spot, May ..	20	9	8

ZINC SHEETS, &c.

Zinc sheets, English	33	15	0
Do. V.M. ex whf.	32	5	0
Rods	39	0	0
Boiler plates	29	10	0
Battery plates ..	31	5	0

ANTIMONY.

Special brands, Eng.	59	10	0
Chinese	40	0	0
Crude	33	10	0

QUICKSILVER.

Quicksilver	21	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—			
25%	8	0	0
45/50%	12	15	0
75%	20	0	0
Ferro-vanadium—			
35/40%	14/3 lb. Va.		
Ferro-molybdenum—			
70/75% c. free ..	4/3 lb. Mo.		
Ferro-titanium—			
23/25% carbonless ..	1/2 lb.		
Ferro-phosphorus, 20/25%	£18	0	0
Ferro-tungsten—			
80/85%, c. fr.	1/3 lb.		
Tungsten metal powder—			
98/99%	1/7 1/2 lb.		
Ferro-chrome—			
2/4% car.	£32	0	0
4/6% car.	£22	0	0
6/8% car.	£21	15	0
8/10% car.	£21	0	0
Ferro-chrome—			
Max. 2% car.	£33	15	0
Max. 1% car.	£39	0	0
Max. 0.70% car.	£45	0	0
70% carbonless	1/1 lb.		
Nickel—99% cubes or pellets	£175	0	0
Ferro-cobalt	9/- lb.		
Aluminium 98/99% ..	£105	0	0
Metallic chromium—			
96/98%	2/8 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	10	0
76/80% packed	£14	10	0
76/80% export	£13	5	0
Metallic manganese—			
94/96%, carbonless ..	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0	2	3
Finished bars, 18% tungsten	£0	2	9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/4 in. to 1/2 in.	3d. lb.
Do., under 1/4 in. to 1/8 in.	1/- lb.
Flats, 1/4 in. × 1/2 in. to under 1 in. × 1/8 in.	3d. lb.
Do., under 1/4 in. × 1/2 in. ..	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf ..	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	7	6 to	3	9	0
Bundled steel and shrngs. ..	3	2	6 to	3	7	6
Mixed iron and steel ..	3	0	0 to	3	2	6
Heavy cast iron		3	0	0		
Good machinery for foundries ..	3	2	6 to	3	5	0
Cleveland—						
Heavy steel		2	17	0		
Steel turnings		2	8	6		
Cast iron borings ..		2	3	0		
Heavy forge		3	10	0		
Bushelled scrap		3	2	6		
Cast-iron scrap	3	2	0 to	3	6	0
Lancashire—						
Cast-iron scrap		3	2	6		
Hvy. wrought .. .		2	17	6		
Steel turnings		2	2	6		

London—Merchants' buying prices delivered yard.

Copper (clean)	53	0	0
Brass	38	0	0
Lead (less usual draft) ..	18	10	0
Tea lead	16	10	0
Zinc	16	10	0
New aluminium cuttings ..	70	0	0
Brazier copper	48	0	0
Gunmetal	49	0	0
Hollow pewter	160	0	0
Shaped black pewter ..	115	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	69/6
Hematite M/Nos.	69/-
N.W. Coast—	
Hem. M/Nos. d/d Glas. ..	79/6
,, d/d Birm.	86/6
Midlands—	
Staffs. common*	67/6
,, No. 4 forge ..	57/-
,, No. 3 fdry.	60/-
Shrops. basic	—
,, Cold blast, ord.* ..	—
,, ,, roll iron* ..	—
* d/d Birmingham.	
Northants forge	52/6
,, fdry. No. 3 ..	56/-
Derbyshire forge	59/-
,, fdry. No. 3 ..	62/6
,, basic	61/-
Scotland—	
Foundry No. 1	75/-
,, No. 3	70/-
Hem. M/Nos.	74/-
Sheffield (d/d district)—	
Derby forge	62/6
,, fdry. No. 3 ..	65/6
Lincs. forge	64/6
,, fdry. No. 3 ..	67/6
E.C. hematite	81/6
W.C. hematite	84/-
Lincs. (at furnaces)—	
Forge No. 4	60/-
Foundry No. 3	63/-
Basic	61/6
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3 ..	70/-
Northants foundry No. 3 ..	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3 ..	87/6
Glengarnock, No. 3 ..	87/6
Gartsherrie, No. 3 ..	87/6
Monkland, No. 3 ..	87/6
Shotts, No. 3	87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.	9	10	0 to	10	15	0
Nut and bolt iron	8	12	6 to	8	15	0
Hoops				11	10	0
Marked bars (Staffs.) f.o.t.				12	0	0
Gas strip				11	10	0
Bolts and nuts, 1/2 in. × 4 in.				15	5	0
Steel—						
Ship plates				8	7	6
Boiler plts.				10	10	0
Chequer plts.				10	12	6
Angles				7	17	6
Tees				8	17	6
Joists				7	17	6
Rounds and squares, 3 in. to 5 1/2 in.				8	17	6
Rounds under 3 in. to 1/4 in. (Untested)				7	15	0
				and upwards		
Flats, over 5 in. wide and up				8	7	6
Flats, 5 in. to 1 1/2 in. ..				7	17	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs.)				10	0	0
Black sheets, 24g. ..				10	0	0
Galv. cor. shts., 24g. ..				13	5	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft	6	5	0 to	6	15	0
Billets, hard	7	2	6 to	7	12	6
Sheet bars ..	6	0	0 to	6	2	6
Tin bars ..	6	0	0 to	6	2	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2 1/2
Sheet to 10 w.g.	1 3
Wire	1 3 1/2
Rods	1 3
Tubes	1 8 1/2
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising ..	9d. to 1/3
Rolled—	
To 9 in. wide ..	1/3 to 1/9
To 12 in. wide ..	1/3 1/2 to 1/9 1/2
To 15 in. wide ..	1/3 1/2 to 1/9 1/2
To 18 in. wide ..	1/4 to 1/10
To 21 in. wide ..	1/4 1/2 to 1/10 1/2
To 25 in. wide ..	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5 1/2
Ingots rolled to spoon size	1/- to 1/8 1/2
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila. ..	20.76
No. 2 foundry, Valley	16.75
No. 2 foundry, Birm.	16.00
Basic	17.11
Bessemer	18.76
Malleable	18.76
Grey forge	18.01
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	32.00
O.-h. billets	32.00
O.-h. sheet bars	33.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd., 9 and 10 ..	2.00
Wire nails	2.55
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplates, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	22/-
Durham and North.	
,, foundry	14/6 to 15/-
,, furnace	14/-
Other Districts, foundry ..	—
,, ,, furnace (basis) ..	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes ..	20×14	box ..	18/-
,, ..	28×20	,, ..	37/-
,, ..	20×10	,, ..	27/-
,, ..	18 1/2×14	,, ..	19/-
C.W.	20×14	,, ..	17/-
,, ...	28×20	,, ..	34/-
,, ...	20×10	,, ..	22/-
,, ...	18 1/2×14	,, ..	15/-
Terneplates ..	28×20		34/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered,	£17 10 0 to £18 10 0
Rolled Ord. ..	£15 0 0 to £15 10 0
Nail rods ..	£15 7 6 to £15 15 0
Keg. steel nom. ..	£33 to £35
Faggot steel nom. ..	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron ..	£5 15 0 to £6 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6in.

	Tubes.	Fittings.
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
June 21	..	63	3	9	inc.	1/3
,, 22	..	63	1	3	dec.	2/6
,, 25	..	63	2	6	inc.	1/3
,, 26	..	62	18	9	dec.	3/6
,, 27	..	63	2	6	inc.	3/6

Electrolytic Copper.

		£	s.	d.		
June 21	..	68	15	0	No change	
,, 22	..	68	10	0	dec.	5/-
,, 25	..	68	10	0	No change	
,, 26	..	68	10	0	,,	,,
,, 27	..	68	10	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
June 21	..	211	7	6	inc.	15/-
,, 22	..	207	15	0	dec.	72/6
,, 25	..	211	0	0	inc.	65/-
,, 26	..	207	5	0	dec.	75/-
,, 27	..	210	10	0	inc.	65/-

Tin (English ingots).

		£	s.	d.		
June 21	..	210	5	0	dec.	5/-
,, 22	..	206	5	0	dec.	80/-
,, 25	..	209	10	0	inc.	65/-
,, 26	..	205	15	0	dec.	75/-
,, 27	..	208	15	0	inc.	60/-

Zinc Sheets (English)

		£	s.	d.		
June 21	..	33	15	0	No change	
,, 22	..	33	15	0	,,	,,
,, 25	..	33	15	0	,,	,,
,, 26	..	33	15	0	,,	,,
,, 27	..	33	15	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
June 21	..	25	11	3	inc.	3/9
,, 22	..	25	12	6	,,	1/3
,, 25	..	25	11	3	dec.	1/3
,, 26	..	25	3	9	,,	7/6
,, 27	..	25	8	9	inc.	5/-

Lead (English).

		£	s.	d.		
June 21	..	22	0	0	No change	
,, 22	..	22	0	0	,,	,,
,, 25	..	22	0	0	,,	,,
,, 26	..	22	0	0	,,	,,
,, 27	..	22	0	0	,,	,,

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1890	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 14 3	0 14 3	0 15 7½	0 15 7½	0 15 7½	0 15 2½
1891	0 15 7½	0-14 2½	0 14 2½	0 14 2½	0 13 6½	0 13 6	0 13 3½	0 13 0	0 12 11	0 13 0	0 13 7	0 13 1	0 14 0½
1892	0 13 1	0 12 9	0 12 9	0 12 9	0 12 9	0 11 10½	0 12 1	0 12 1	0 12 2	0 12 0	0 12 0	0 11 11	0 12 4½
1893	0 11 11	0 11 5½	0 11 10	0 11 10	0 12 1½	0 12 3	0 12 1½	0 12 3	0 12 1	0 12 4	0 12 4½	0 12 6	0 12 0½
1894	0 12 6	0 12 6	0 12 7½	0 12 1¼	0 12 4	0 12 1	0 12 0	0 12 0½	0 11 10½	0 12 2	0 12 0	0 12 0	0 12 1½
1895	0 12 0	0 12 0	0 11 10	0 12 0	0 12 0	0 12 3	0 12 3	0 12 4	0 12 4	0 12 6	0 12 6	0 12 7	0 12 2½
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9½
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5½
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9½
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 1½	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 5½
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8½
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 0*	1 1 0*	1 1 6*	1 1 6*	—	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 3 0	1 2 0	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	—	—	—	—	—	—	—

* Prices nominal.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

WANTED, for Foundry in London, Foreman, used to modern methods of production; must have had previous experience as Foreman, and be familiar with the use of moulding machines and the manufacture of both ferrous and non-ferrous castings.—Apply in writing, stating age, experience and wages expected, enclosing copies of two testimonials, to Box 60, R. ANDERSON & COMPANY, 14, King William Street, Strand, W.C.2.

FOUNDRY, near London, requires services of a first-class Traveller, with established connection amongst users of light castings; salary and substantial commission; right man can earn £500 a year or more.—Apply, Box 738, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT FOREMAN PATTERNMAKER wanted for Steel Foundry dealing with ship structural castings and general light, medium and heavy castings; must be a practical patternmaker; write stating age, fullest possible details of experience, also experience with systems of payment by results; state salary required; applications will be treated confidentially.—Box 740, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MOULDER for Ironfoundry (London), with experience of large light patterns, also jobbing and plate work, possibilities of working Foreman's position to a good reliable man.—Send full particulars to Box 742, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN PATTERNMAKER required by Stove Grate and Gas Stove Manufacturers; must be able to control men; accuracy and sound experience essential.—Write fully in confidence, stating age, experience and salary required, in first instance, to Box 748, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

PULLEY MOULDING MACHINES.—One for 24-in. pulleys, £20; one for 30-in. pulleys, £30; ordinary curved arm type; will make pulleys 3-in. to 12-in. rim depth.—A. HAMMOND, 14, Australia Road, Slough.

MACHINERY.—*Continued.*

New Cylindrical Grinding Machine, grinding capacity 4-ft. 1-in. x 11¾-in. dia.

8-in. x 16-in. CHURCHILL Plain Grinding Machine, gear-box drive.

Vertical Rotary Surface and Ring Grinding Machine, with 12-in. dia. magnetic chuck.

CHURCHILL No. 2 Automatic Surface Grinding Machine.

DOUBLE CYLINDER HORIZONTAL STEAM WINCHES, double and single purchase types, cylinders 4½-in. dia. to 10-in. dia., extremely large variety.

Ten "LIDGERWOOD" SINGLE PURCHASE STEAM WINCHES, cylinders 8¼ in. x 8 in., drums about 16 in. x 19 in.

Two LANCASHIRE BOILERS, 30 ft. x 8 ft., reinsure 110 lbs. pressure.

About 3,500 ft. of NEW, slightly stock rusty, 1½-in. diameter screwed and socketed Piping, in the usual long random lengths.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD

FOR SALE.—Several second-hand Berkshire Hand Squeeze Pattern Draw Moulding Machines, in perfect condition. Stripping Plate Machines for light and heavy work. Hand Draw Power Rollover and Hand Draw Hand Rollover.—Box 744, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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PROPERTY.

11 ACRES WORKS SITE, SHEFFIELD.

145,000 Sq. Ft. of SHOPPING, Compact and Convenient.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers, or Let on favourable terms. Unique opportunity for Manufacturers.

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THOS. W. WARD, LTD.,
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PATENTS AND TRADE MARKS.

THE Proprietors of the Patent No. 146,085 for Improvements in and connected with Pulverised Fuel Furnaces are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. — All communications should be addressed in the first instance to HASELTINE, LAKE & COMPANY, Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PATENTS AND TRADE MARKS.—*Contd.*

THE Proprietor of British Patents Nos. 208,572 and 208,573, both dated August 14, 1922, relating to "Process for the Production of Sponge Iron" and "Apparatus for the Production of Sponge Iron and other Metallic Products," respectively, is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patents and ensuring their practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois.

INFORMATION HANDBOOKS, Advice, and Cons. free; King's Patent Agency, Ltd.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

MISCELLANEOUS.

GANISTER, best quality, for Cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

PLUMBAGO.—To make room for large arrival middle of July, we offer 20 casks "Special" and 12 casks "Superfine" at 10 per cent. below price list (see our catalogue, page 8); unique opportunity.—WM. OLSEN, LIMITED, Hull.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. BUCHANAN & COMPANY, Ashfield Road, Altrincham, Cheshire.

'Phone: 287 SLOUGH.

CRANE LADLES

15 Ton	EVANS	£70
12 Ton	EVANS	£60
5 Ton	EVANS	£35
2 Ton	EVANS	£24
1 Ton	NEW, latest type	£20

ALL IN STOCK.

EVERY SIZE LADLE (1 cwt. to 15 ton) in Stock

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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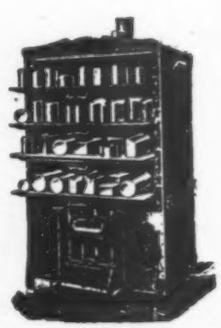


CORE OVEN.

THE "PORTWAY"

PORTABLE CORE OVENS

For Gas or Fuel.

TESTIMONIAL.

From The Braintree Castings Co.,
Chapel Hill Foundries, Braintree, Essex.

Gentlemen,

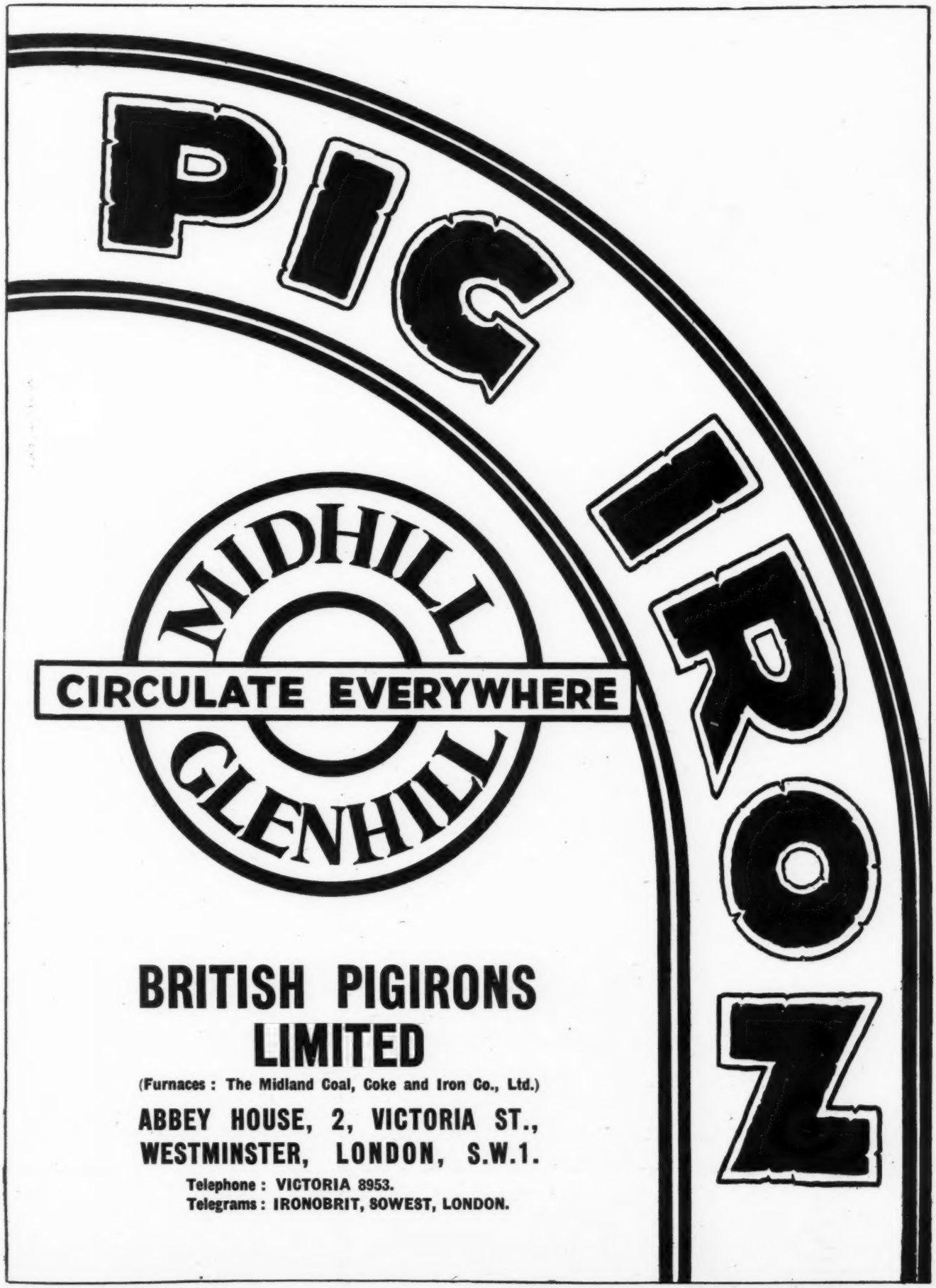
We are very pleased with the Core Oven we recently purchased from you. We find it dries the cores quickly without burning them. It is very handy and economical to use and is altogether superior to other ovens of this type we have in use.

Will you please quote us your best price for four more like it.

Yours faithfully,
For The Braintree Castings Co.,
(Signed) W. B. LAKE, Director.

Makers—

C. PORTWAY & SON, Tortoise Stove & Portway Portable Oven Works, **HALSTEAD, ESSEX.**


PIG IRON
MIDHILL
GLENHILL
CIRCULATE EVERYWHERE
BRITISH PIGIRONS
LIMITED
(Furnaces : The Midland Coal, Coke and Iron Co., Ltd.)
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WESTMINSTER, LONDON, S.W.1.
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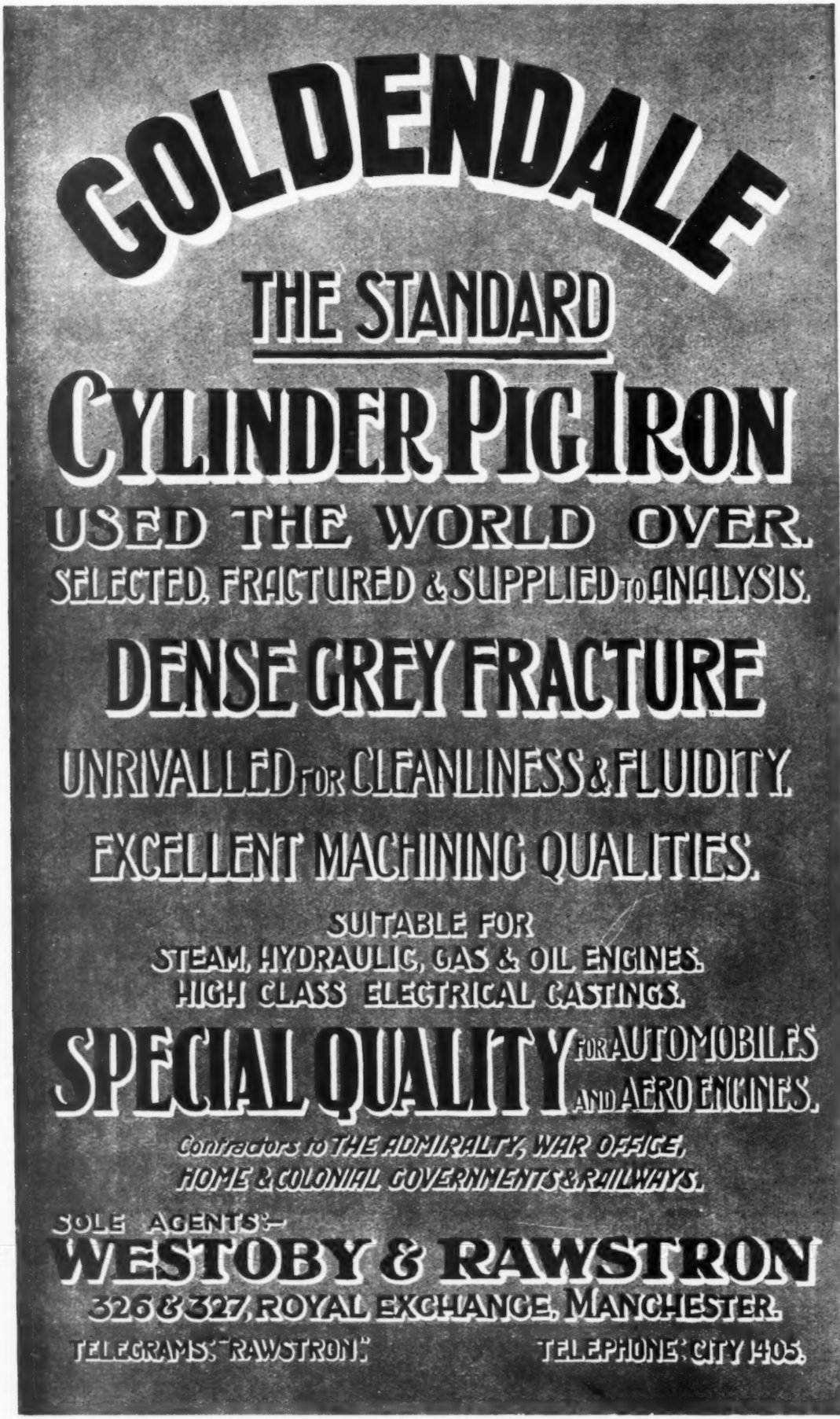
Telegrams : IRONOBRIT, SOWEST, LONDON.


GOLDENDALE
THE STANDARD
CYLINDER PIG IRON
USED THE WORLD OVER.
SELECTED, FRACTURED & SUPPLIED TO ANALYSIS.
DENSE GREY FRACTURE
UNRIVALLED FOR CLEANLINESS & FLUIDITY.
EXCELLENT MACHINING QUALITIES.
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HOME & COLONIAL GOVERNMENTS & RAILWAYS.
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TELEGRAMS: "RAWSTRON." TELEPHONE: CITY 1405.

XUM

XUM

Improved Rapid Cupola

Fitted with PATENT TUYERE DOORS

by means of which each tuyere can be quickly and easily regulated or closed from a convenient position, without obtaining access to the air belt.

Also the

Osborn Patent Spark Arrester

The advantages of which are:—

Immunity from sparks and grit.

Avoids damage to roofs, choking up of gutters.

Prevents danger of fire.

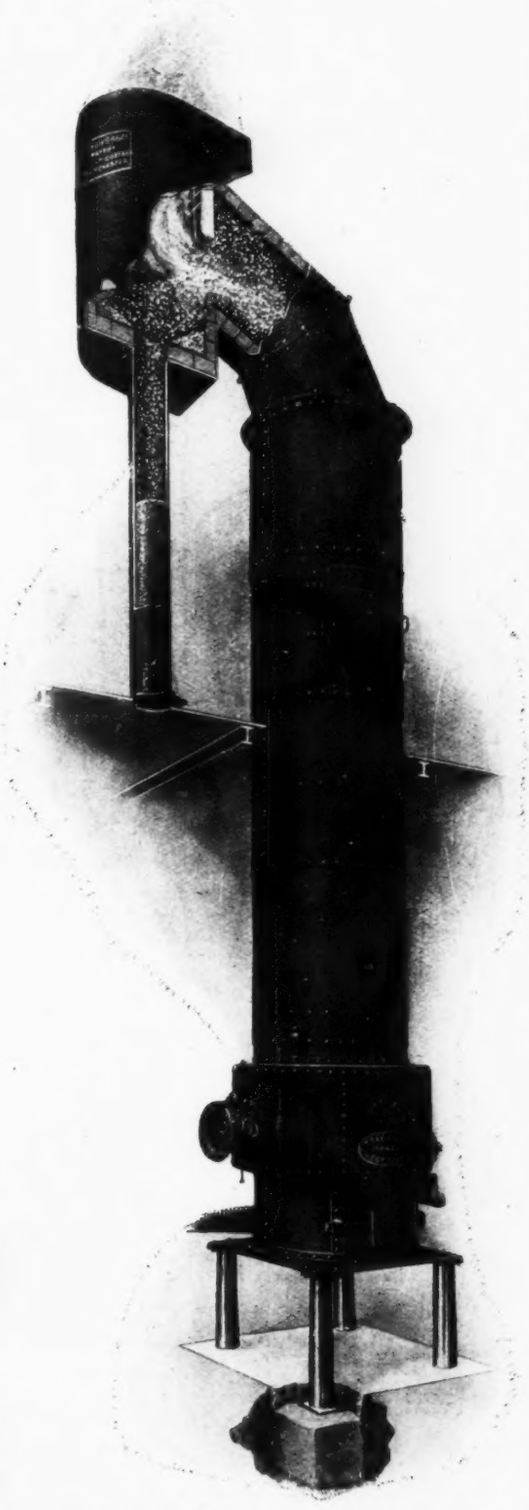
Important labour saver.

Conducts the dust down to or through the charging platform, where they can be dropped into a cart without handling.

Constructed in flanged sections to facilitate erection.

Cannot get overheated, being lined with firebricks.

Can be fitted to existing cupolas.



MAKERS:

T. DAVIES & SON

Railway Ironworks,

WEST GORTON, MANCHESTER

Also Makers of

FOUNDRY CRANE LADLES

Telegrams:—"TUYERE," MANCHESTER. *On Admiralty List.* Telephone No.:—70, OPENSHAW.

SO certain are the advantages of

CUPOLINE

(Trade Mark Registered.)

as the best refractory that you should give it a trial.

We have pleased others,

WHY NOT YOU?

ROBSON REFRACTORIES Ltd.

16, North Road,

DARLINGTON, Durham.

Telephone: 2405. *Telegrams: CUPOLINE, DARLINGTON.*

CUPOLINE STORAGE DEPOTS AT:

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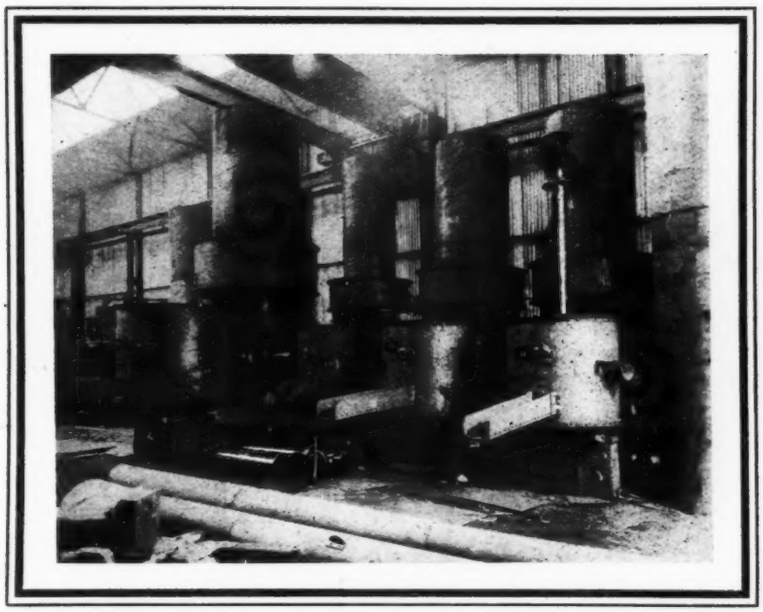

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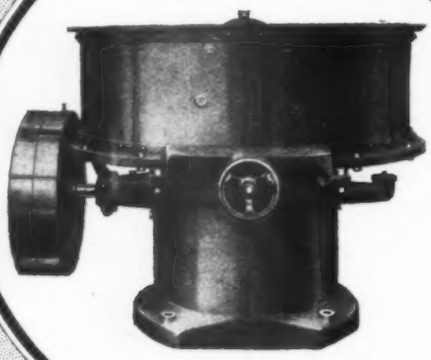

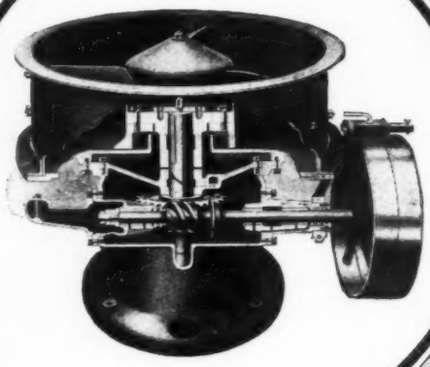

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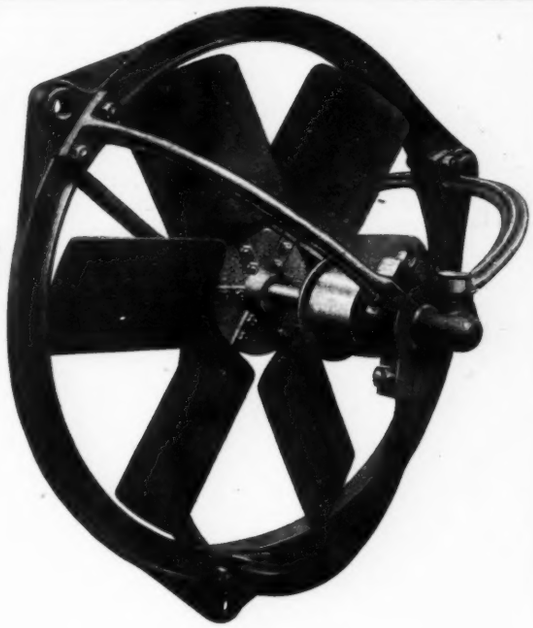

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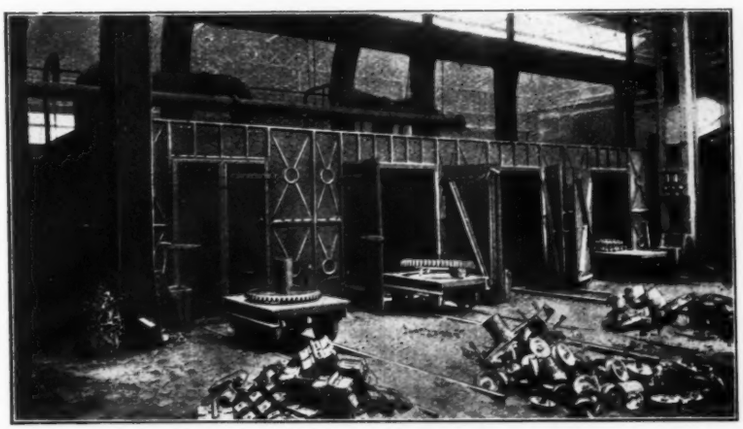

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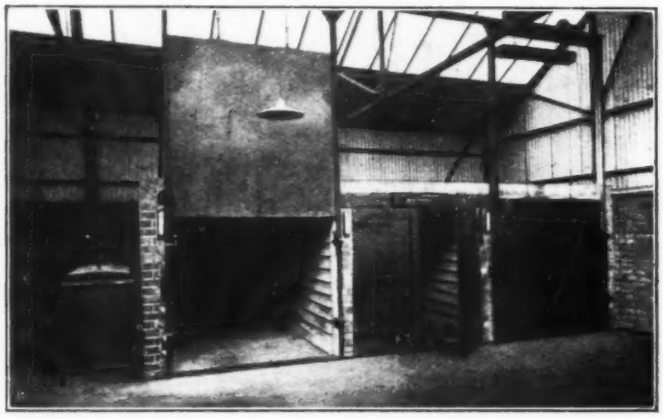

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Findlay, A., & Co., Ltd.	—
Fordath Engineering Co., Ltd.	8
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Furnston & Lawlor	—
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Gleaseri, Dle.	26
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Jacks, William, & Co.	17
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Macnab & Co.	—
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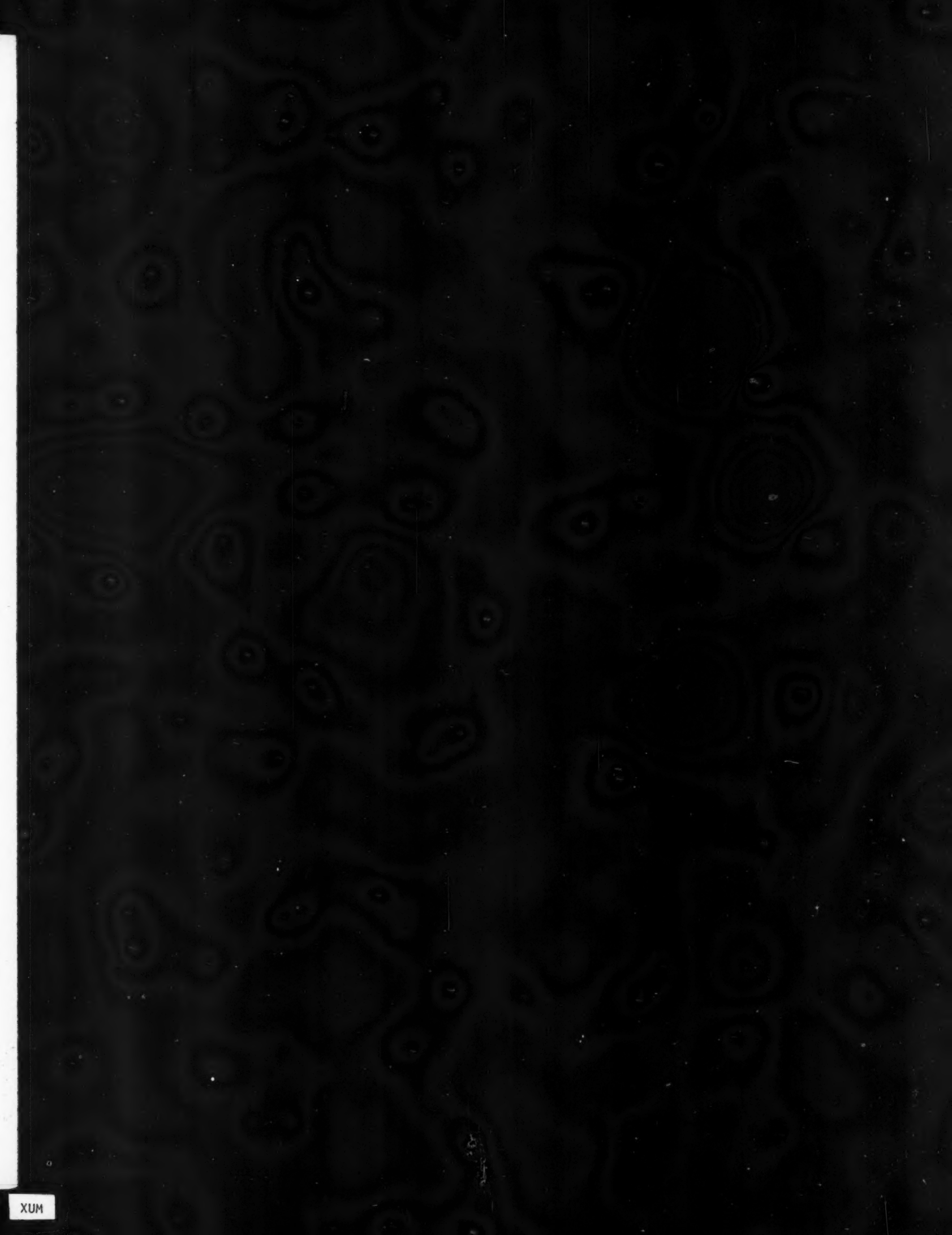

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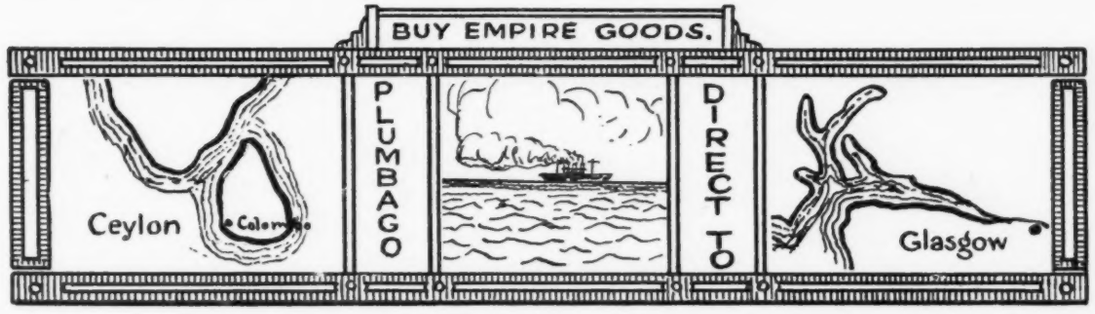

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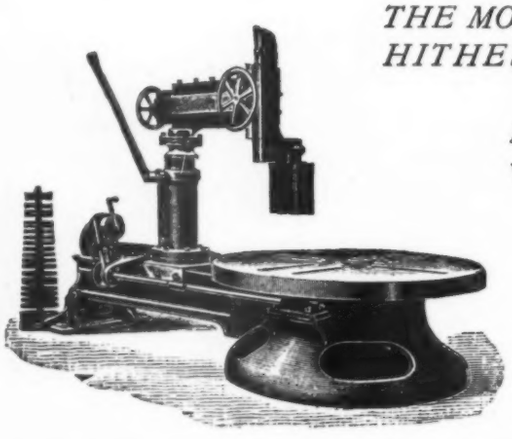

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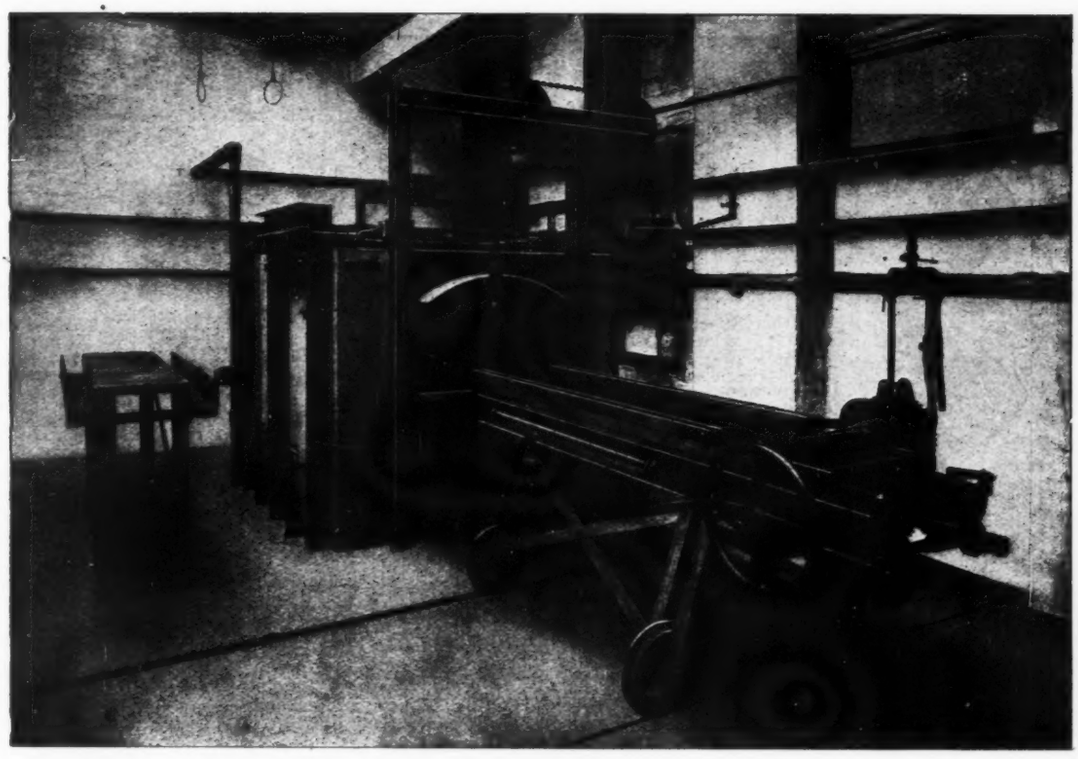

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No. 3 Soft	91.67	3.40	.20	2.90	.03	.70	1.10
No. 3 Medium	91.95	3.25	.35	2.60	.05	.70	1.10
No. 3 Hard	92.49	3.00	.45	2.30	.06	.70	1.00
No. 4 Soft	93.03	2.90	.50	1.80	.07	.70	1.00
No. 4 Hard	93.50	2.75	.65	1.40	.10	.70	.90
Cylinder Iron	93.77	2.60	.65	1.50	.08	.70	.70
Mottled	93.95	2.00	1.50	.90	.15	.70	.80
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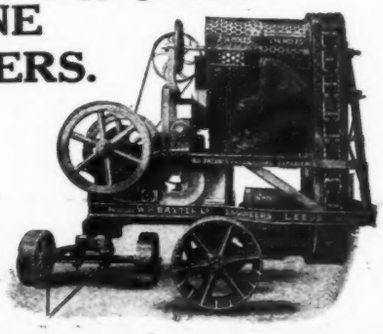

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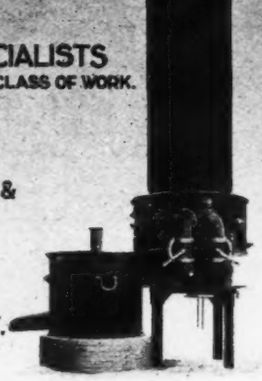

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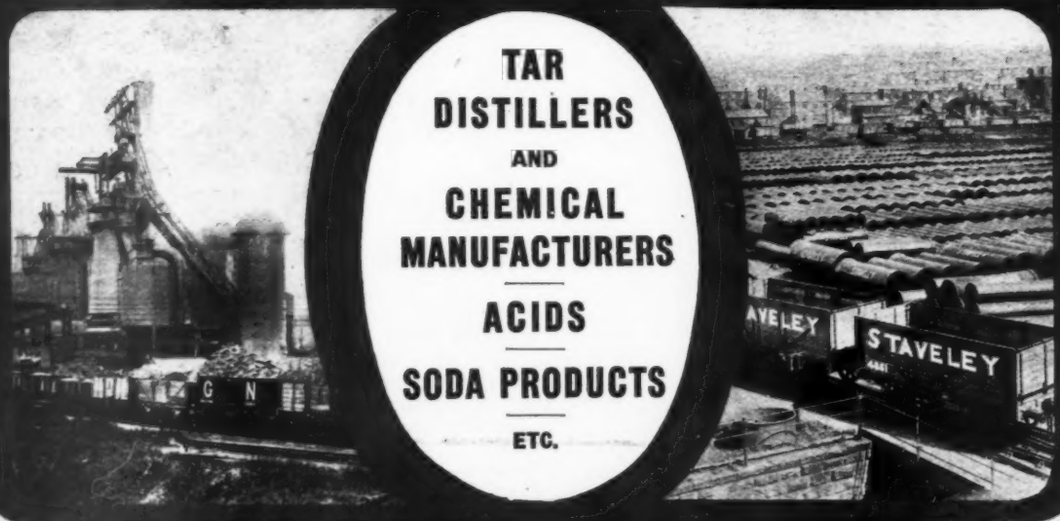

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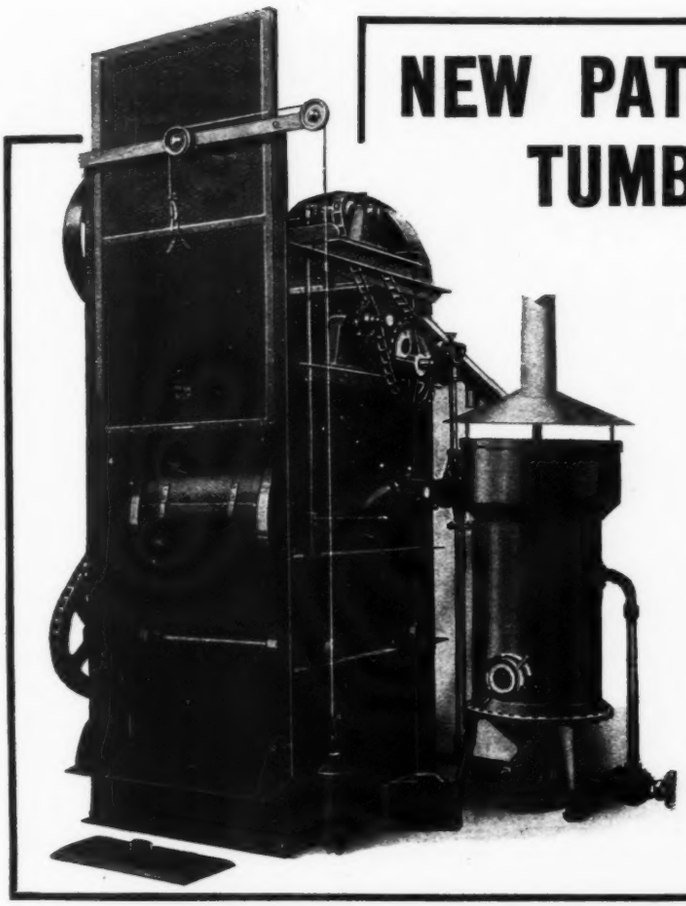

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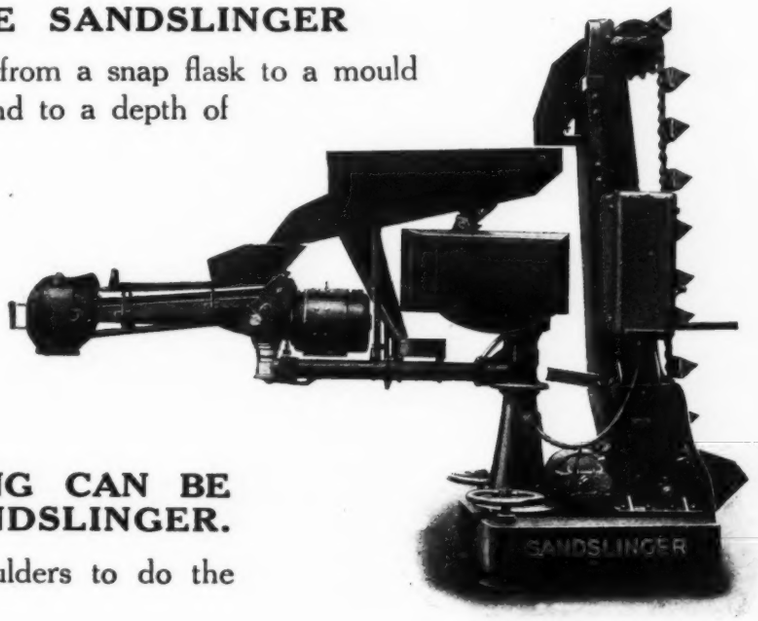

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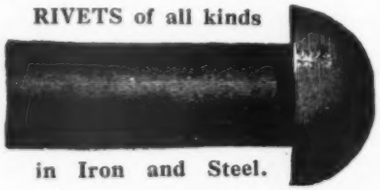

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